WITH EIGHT-PAGE SUPPLEMENT.

ELECTRICAL REVIEW

ILLUSTRATED.

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The Arc Lamp on Alternating Circuits.

The whole subject of the arc lamp on alternating circuits wants thrashing out, according to *London Industries*. Many authorities hold that alternating arc lamps should be avoided because of their inefficiency. The power is distributed over two craters, so that the light is, roughly speaking, only equal to that of two direct current arcs, each taking half the power. In addition to this one crater is on the lower carbon, and wastes most of its light by dispersing it upwards into space. Special direct current circuits are sometimes run for the sake of the arc lamps, as for instance, in Chelmsford. The efficiency may be lower, though we do not remember having seen any tests; but still it is advisable to run arc lamps from alternating circuits, as any inefficiency is more than balanced by saving the cost of extra direct current plant.

Alternating arc lamps may be run from 100 volt circuits two in series, or from 50 volt circuits in parallel, or in series circuits. The latter plan has been adopted by the Westinghouse Company, who have worked out a complete alternating arc system, beginning with the dynamo and ending with the lamp. An arc system worked out by the engineers of the Westinghouse Company is sure to have received the greatest attention in every detail, and to be good, practically; but many of the points in it seem so curious that they awaken discussion.

The arcs are in series, on transformers. Where convenient there are three or five lamps to a transformer, in other cases there is a transformer for each lamp. In a series system the tranformers merely prevent the dangerous pressures from coming into the houses; they have no other effect of importance, and may, therefore, be left out of the discussion. There is, of course, a slight loss by resistance, which has some inappreciable regulating tendency. It may also be remarked that the loss of power in the iron does not go on when the lamp is not in use, as short circuiting the secondary of a series transformer reduces the induction to very small values. The extraordinary thing is that the Westinghouse Company should work out a series system when they have, in most of the towns where they will instal arcs, a parallel system already running. The series dynamo is specially designed to give a "drooping" curve, but this result can be very easily obtained in parallel work by means of a choking coil, and the choking coil allows single arcs to be run off 100 volt circuits with steadiness and economy, an advantage, of course, unattainable on direct circuits. We can only hazard a guess that arc lamps have been tried two in parallel on a 100 volt circuit and did not work well, and that choking coils with closed iron circuits were also tried without success. It does not seem to be generally realized that a choking coil should always have an open iron circuit.

The need of a drooping curve for the satisfactory working of the lamps used is shown by the design of the dynamo, whose armature current reacts powerfully on the field; or, as it is commonly put, has a large coefficient of self-induction. This reaction is said to be so great that the armature current does not increase above the normal, even on short circuit. This is, of course, impossible; still the armature reaction is very great. Now this reaction has an effect very similar indeed to that of a choking coil in the circuit; why, then, should the lamps not be run off the parallel circuits with open iron circuit choking coils?

Another innovation is the change from 130 to 62 periods per second. Of course, the pitch of the objectionable hum is thus lowered an octave, from tenor C to bass C, in fact. There is also less trouble in making electro-magnets. A given electro-magnet which, with a frequency of 130, gives, with a certain pull, a back pressure of, say, 20 volts, gives the same pull with only 10 volts with a frequency of 62, or, in other words, it chokes less. Apart from these small matters, we cannot see any reason for altering the frequency. The whole subject is so important that it is earnestly to be hoped that the Westinghouse Company will put the public in fuller possession of the considerations that have led to their latest departure.

An Electric Light Coalition only in Embryo.

Mr. Henry Villard's confidential secretary said to a New York *Sun* reporter that the proposed combination of electric lighting systems in this and other cities had not as yet reached any definite form. It was true, he added, that Mr. Villard had been negotiating for some weeks past with representatives of a number of electric power companies, but all reports specifying any combination of certain named companies were absurdly inaccurate. It was proposed to form such a coalition as would insure to the different companies the highest financial returns on the development and extension of all electric patents. The plan was still embryotic, and so thoroughly immature that no particulars were obtainable.

Mr. C. R. Dean, of Curtis & Dean, agents in this city for the Thomson-Houston Company, was ignorant of any proceedings toward an electrical trust.

President George Westinghouse, of the Westinghouse system, hadn't the slightest knowledge of the contemplated combination.

Wills' Electric Recording Steam Gauge.

This recording apparatus consists in the combination of the moving parts of a pressure gauge with a stylus for printing on a movable chart through the medium of an inked ribbon.

The rise or fall of steam in the gauge causes the stylus to rise and fall on the ribbon placed vertically against the side of a revolving cylinder. On this cylinder is fastened a card or chart which is printed with horizontal lines representing the degrees on the steam gauge and with vertical lines slightly curved to accord with the arc of which the stylus arm is the radius, and representing the hours of the day. This cylinder is turned by a clock so that every vertical line on the chart will pass under the inked ribbon once in 24 hours. The clock has another use. Midway between the gauge and the revolving cylinder are placed two electro-magnets, equal in strength to three single magnets. They are provided with an iron shield, fixed on the side nearest the stylus arm. On the part of the arm passing this shield a corresponding piece of iron is fastened. At intervals of one minute the clock effects a connection and sends a current through the magnets. It magnetizes the iron shield and that draws the stylus arm to it. This motion causes the stylus to strike the inked ribbon, leaving a single dot on the chart, which registers its relative position to the horizontal lines at that particular minute.

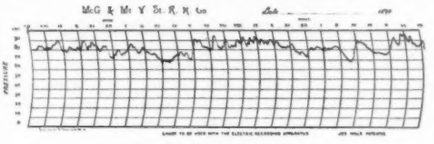

FIG. 2.—CHART OF SAME.

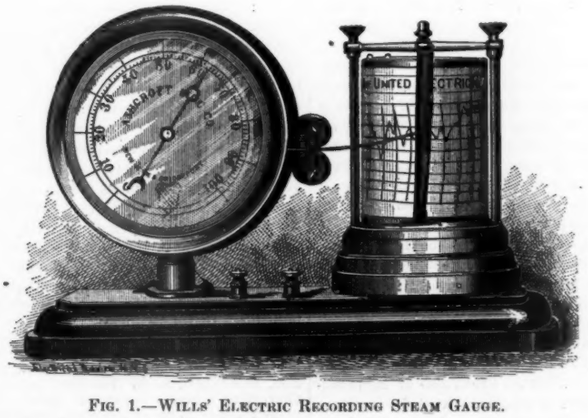

FIG. 1.—WILLS' ELECTRIC RECORDING STEAM GAUGE.

The construction is very simple. Current is furnished by a Crowdus dry battery. In the morning when the sheet of paper is taken off and spread out, it presents the line of variation, written from one side of the page to the other, and showing the whole steam record of the last 24 hours.

Our illustrations show the apparatus and the chart spread out. The inventor is Mr. Joseph Wills, of Nashville, Tenn.

Large Crowds Successfully Carried.

Decoration Day demonstrated the ability of the electric system of street car propulsion to take care of enormous loads. In the cities the amount of travel imposed upon the electric cars was far in excess of that for which they were intended, but in spite of the enormous loads carried in each case the operation of the cars is successful in every particular.

At Cleveland, on May 30th, occurred the ceremonies connected with the dedication of the Garfield Memorial, and the city was crowded with strangers who took the electric cars to the park. The greater part of these people were carried by the Sprague electric cars on the East Cleveland Street Railway, though many passed over the lines of the other two street railways in Cleveland. The cars on all three lines were crowded with passengers. Many of the cars ran trailers, and both motor car and trailer were taxed to their uttermost capacity.

In Buffalo, on the following Sunday, the four electric cars in operation on the Buffalo Street Railway ran all day long, drawing one or two trailers each.

It is said that the managers of the roads in both of these cities are very enthusiastic over the operation of the cars, and the press of the city has spoken in the highest terms of the performance under the most trying condition.

Thermo-Electricity.

Should success attend an invention which has been brought to the notice of Hartford capitalists, says the Hartford *Times*, for converting heat directly into electricity, it may result in giving the world a new and important discovery, as well as in establishing another large industry in this city, where the new enterprise will be controlled.

The invention is in the line of thermo-electricity. It is claimed that it generates electricity from fire, and this without engines, dynamos, or any of the usual range of machinery for producing electricity. It is the invention of Mr. H. B. Cox, formerly of Cincinnati, but now of Hartford, who, although yet a young man, has had an extended experience in electrical science. His experimental machinery gave such satisfactory results that a company has been organized, with $1,000,000 capital, with these officers: President, Francis A. Pratt, of the Pratt & Whitney Company; vice-president, R. N. Pratt, of the Pratt & Cady Company; secretary, F. C. Rockwell; treasurer, Ernest Cady, of the Pratt & Cady Company. E. Henry Hyde, of Hyde & Joslyn, attorneys, is legal adviser of the company.

The gentlemen interested in the enterprise decline to give an explanation, at this time, of the method employed for producing electricity. They claim, however, that Mr. Cox has solved the problem which has so long puzzled electricians on both sides of the Atlantic, and on which Edison has been working for years. They believe that the invention will afford an electric power strong enough to be of great commercial value, and which, by its cheapness, will supersede the use of steam. Mr. Cox was in Washington this week, and his patents were allowed. Foreign patents will also be applied for. The details of the invention will not be disclosed until these matters are settled and working machinery, suitable for the market, has been made. Mr. Cox is now permanently located here supervising operations.

Electricity as a Hastener in the Tanning of Hides.

It is somewhat remarkable that so little application has been made of electricity to industrial processes in which chemical operations are involved. If the metallurgical operations of electro-depositing and electric smelting be excepted, the Cassel gold chlorination, Hermite's bleaching, Webster's sewage, and Figgé's unsavory process for "de-gumming" rhea fibre, have alone been tried on any large scale. Regarding an electric current as a mode of conveying energy, it has to compete with heat and the various forms of chemical energy, the applications of which entail generally a comparatively small outlay for plant; but where a distinct local effect, or where the action of so-called nascent elements is required, it would seem that electricity might frequently be employed with economy.

Many of the most important chemical processes of the day have been worked out in the laboratory by the patient applications of chemical principles at the hands of skilled chemists, and in this respect the electric method of tanning is singular, since we have not been able to hear of even the existence of a chemical hypothesis to account for its results. The British Tanning Company have recently started at Rothesay street, Bermondsey, London, S. E., a practical method of tanning by "electricity." The company was formed about a year ago to work in this country the patents of Worms and Ball, who, after many experiments, managed in Paris to successfully overcome the difficulties which Goulard and the earlier investigators in this direction had met with. It will be within the recollection of many of our readers that at the Paris Exhibition several specimens of leather tanned in France by this process were shown in the saddlery department. The English company at first started with a small plant of French manufacture, but they have recently erected a new series of drums, which have been at work for some weeks past, yielding very satisfactory results. In the present process, the hides, after the usual liming and depilating process, are transferred to large wooden drums, nearly 12 feet in diameter, and as many feet in length. These are mounted on a horizontal axis so arranged as to permit of being slowly rotated by steam power. Each drum is then charged with about 500 gallons of ordinary tanning liquor of about 20 degrees strength, made from either oak bark or chestnut, and, after the addition of a small quantity of turpentine, is hermetically sealed. Thus far the method differs but little from the various processes which have been tried with small success to substitute for the hand labor involved in daily turning the hides a mechanical movement to the tanning extract and suspended hides. In the electrical process which we had an opportunity of seeing at work last week a few feet of copper wire, forming the electrodes for a current which enters at one end and leaves at the other, are fastened within the flat sides of the rotating drums. The copper electrodes are provided on the shafts outside with rubbing contacts, consisting of ordinary dynamo brushes, to which the leads from a small dynamo are attached. At the Bermondsey works there are five such drums, and a current of 12 amperes at a pressure of 70 volts is used, or about 14 volts for each drum. The joint effect of this mechanical agitation of the pelts and liquor and the passage of this low density current is stated to reduce the time required to successfully tan half a ton of hides per drum from several months to four or five days. After working for some little time a slight heating of the liquor is noticed, and the electrolytic gases produced exert a small pressure within the drum, which is controlled by a spring valve, but no data seem to be forthcoming as to what influence this increase of temperature and pressure have upon the result. The former effect might, of course, be obtained more economically, while the latter is in this case small, and has been applied much more elaborately in the hydraulic process of Spilsbury, in 1823, and the vacuum process of Knowles and Duesbury, both of which failed many years ago.

We are informed that the simple mechanical agitation has been found to reduce the time necessary for tanning to one-half, the rest of the great economy being attained by the inexplicable electric action. It is obvious that it is extremely difficult even to devise experiments which would be successful in differentiating the part played by the various forms of energy which apparently influence the result, but until this is done, a full explanation of the increased rapidity of the tonnage is impossible.

A considerable stock of finished butts and skins were on view at the time of our visit; and in the opinion of experts the tanning process was stated to be fairly complete and well struck through, but the butts were generally more supple than is considered advisable for boot soles. The continual mechanical agitation in bulk would naturally open the pores of the hide; and it is suggested, somewhat vaguely, that the electric current has a similar effect, presumably in a manner akin to the action of a current on osmosis and dialysis, though in this case there is no definite direction, as the hides are being continually churned in the liquor. Turnbull, in 1845, patented a process in which endosmosis of the liquor through the pelts was hastened by forming them into bags, into which the ground tanning material was placed, together with water, and then immersed in a strong extract of catechu, but the method has not found favor with manufacturers generally. It is difficult to see what useful electrolytic action can take place, for it is not claimed, as in the bleaching process, that any chemical changes are produced, nor would such action favor any ferment of the liquor or dehydrating action.

The chemistry of the tanning process is still very obscure, and, as we have already pointed out, there is a great deal of systematic scientific research required before a satisfactory explanation of the new method can be given. Although the electric current does undoubtedly do a small amount of electrolytic work within the drum, it is probably confined to the water and inorganic salts present, as it has yet to be shown that complex molecules of the gallic and tannic acid type can be decomposed in this way. It must not, however, be forgotten that all tannins are characterized by a great avidity for oxygen, and it may be that a temporary oxidation of the active tanning principle renders it in a position to enter more readily into condensation with the gelatine of the pelt. It has been suggested that the action may be analogous of that of a mordant in dyeing, the ions liberated by the electric current determining the motion of the tannin molecules in the solution towards the gelatine. It is difficult to imagine that the electric current has any direct effect on the condensation of the gelatine and tannic acid in the production of leather, as there is no extraneous evidence to warrant the assumption that an electric current is capable of acting as a dehydrating agent. In the production of leather from the simpler molecules one would imagine that heat would be evolved, and that, therefore, it would be unnecessary to furnish additional energy to bring about the change.

The system at work at the British Tanning Company's place does not stand alone, but the results, unintelligible though they be, are confirmed in a highly satisfactory manner by a different application of electricity under the Groth patents, which have recently been tried on a less extensive scale by Messrs. Tebbitt Bros., also of Bermondsey. Here a circular vat (of somewhat smaller dimensions than the drums of the British Tanning Company) is provided with a central shaft and eight strong arms of wood, four at the top and four at the bottom. On these the hides are firmly fastened, and the whole revolves like a huge paddle, the vat being stationary, like a brewer's mash tun. At opposite ends of a diameter, two vertical strips of copper are placed against the sides of the vat, and a current of about 12 amperes is passed. Here there is no appreciable heating, and, of course, no pressure. The hides, so far from being continually churned together, are not even subject to the ordinary daily handling, but remain strained flat during the whole operation. In stiffness and thorough tanning the resulting butts are admirable, and apparently are better adapted for boot soles and other purposes requiring a hard leather than that now being produced in the rival process. The copper electrodes waste away, as might be expected, but the British Tanning Company can discover no injurious result, nor can they detect its presence in the leather. Messrs. Tebbitt Bros., on the other hand, partly attribute the color of their leather to the presence of copper, and propose to use an alloy in its place, though we should imagine that carbon electrodes would overcome this difficulty. In specimens of the leather manufactured by this latter process, which we have inspected, the color was much darker than that of the former, but we understood that the butts were tanned by a prepared extract, which is well known gives a darker color than when a bark liquor is employed. One would imagine that in the Groth process the stretching of the pelts upon the wooden frames would facilitate a regular and uniform tannage, while in the alternative process the beating and flapping of the loose hides against one another and the sides of the revolving drum would have a tendency to soften the leather.

It seems a pity to ask too much of so promising a system. To reduce the time at one bound from many months to a few days is to spur a willing horse. Messrs. Tebbitt Bros., prefer to feed the hides with a weak liquor first, and are satisfied if the tanning is complete in two or three weeks. A strong liquor acts at once on the outer surfaces, and prevents the process from extending to the middle of the hide, and though we did not observe that this was the case at the British Company's place, we think that another fortnight in an ordinary pit would give greater firmness to their butts. The whole economy is one of time—there are no complications of new or cheaper chemicals, or utilization of waste products; indeed, there is the introduction of motive power and electric machinery; but the advantage consists in the reduction of the large idle capital which lies in the tanner's yard in the form of costly liquor and half-tanned leather, besides the possibility of a rapid turnover and economy of space. The amount of energy expended in electricity is very small; the British Tanning Company use the current for 12 hours out of 48, and its cost for the half-ton of hides tanned per drum at 8*d.* per Board of Trade unit would be only 3*s.* 4*d.*

More than 40 years ago Peter Barlow wrote: "Of late years considerable changes have taken place in the modes of tanning, so that this operation, which a few years ago took several months to complete, can now be done in as many days;" but he goes on to say, "the leather, however, made by this hastened process is considered to be less perfect than by the old method, an opinion which is supported by many eminent tanners and scientific men, among whom may be mentioned Sir Humphry Davy." While the former part of this quotation exactly expresses the result of the electric methods of tanning, we hope that history will not repeat itself, but that we have in these processes the beginning of a new and important industry. In the application of electricity to any industry, considerable time must necessarily elapse before "the trade" will give way its prejudices against a new process, and when, as in this case, there are alternative schemes before the public, the delay is likely to be prolonged by litigation. We believe that both processes are capable of yielding a valuable commercial leather, and that the manufacturers who adopt the new method will find that there are many advantages both in time, labor and space, over the older methods of tanning.—*London Industries.*

The Sandusky, Ohio, street railroad was sold last week to C. E. Foote, of Cleveland, James and William Christie, of Akron, and C. E. Cook, of Chicago, who will make it an electric road. The price paid is understood to be $45,000.

The Largest Yet.

The application of electricity to mining operations received a great impetus recently. Last week, Mr. T. F. Clohesey, the well-known electrical engineer, of Kansas City, Mo., closed a contract to furnish the Jasper County Electric Power Company, as the organization is known, with a 1,000 horse-power plant, the largest stationary electric power plant in the world. The Detroit Motor Company furnishes the plant, and 150 motors, ranging from five to 20 horse-power, were included in yesterday's sale.

By the use of electricity a mine can be operated at all times, light and power being furnished at night as well as by day. No mules will tire or boilers need repairing or cleaning.

The plant at Webb City will be placed in position and operation at once. Two hundred horse-power will be in operation in 30 days, an additional 300 horse-power in 60 days and the balance in 90 days. The price of the plant is $98,000.

The Jasper County Power Company has a stock of $150,000, all paid up, and expect to have 2,000 horse-power in operation inside of a year. The company has a 30 years' franchise and its officers are: Hon. W. P. Munro, Nevada, president; Judge D. P. Stratton, Nevada, counsel; O. K. Caldwell, Nevada, treasurer; Hon. T. F. Clohesey, Kansas City, secretary and electrical engineer. These gentlemen are all prominent, the latter being especially well known as an electrical expert and engineer of many years experience.

The power will be distributed over a radius of one-half to three-quarters of a mile from the two cities, and will be used in hoisting, ore crushing, pumping, jigging, tramming and various other channels; also furnishing light for the mines.

Mr. Clohesey leaves Kansas City on a trip East for the purpose of purchasing ten 50 horse-power generators and copper wire for the distributing system.

The Electrical Exhibit.

Louis Stieringer, Edison's special agent, who is in Minneapolis to draw plans for the electrical lighting exhibit at the exposition, made his first visit to the building last week. He was much pleased with the opportunities which the building affords for an effective lighting display. There was every chance, he said, to carry out the plans just as he would wish them, and he could promise the management, right at the start, that the exhibit would be immeasureably superior to any ever given before. According to a St. Paul paper, the exhibits at Paris and New York will be discounted.

Electricity in Favor.

A somewhat significant "sign of the times," says an exchange, was given at one of the sessions of the recent meeting of the American Society of Mechanical Engineers, at Cincinnati. One member read a paper in which he showed that to equip and operate an ordinary steam railroad to use electricity would be so enormously expensive that it could not possibly compete with the steam locomotive. A most spirited debate ensued. Half a dozen or more mechanical engineers rose up to defend "electric power" against the attack, and criticised his estimates and statements and the work of electrical engineers in general, in an astonishing manner. It looked like a friendly battle between the electrical engineers and the mechanical, in which the latter were fighting for instead of against electricity.

From Buffalo.

The public is very quick to coin a new word when one is needed, and when the word is coined it can seldom be changed. Elbridge T. Gerry narrowly escaped the dubious honor of having the electric machine which was made for Kemmler's taking-off named after him. He was chairman of the commission appointed by the Legislature to investigate the advisability of substituting electricity for the gallows! The committee proposed that the name "Gerrytine" be given to the electrocution machine, and it was all the commodore could do to stop it. He promptly resigned from the commission, and is scared even now when the word "Gerrytine" is mentioned. "Gerrytine" sounds better than the clumsy phrase "electrocution," but it is probably too late to make a change.—*Buffalo Express.*

Aluminium by the Heroult Process.

A short time ago we gave an illustrated description of the Heroult process of making aluminium, as practiced at Boonton, N. J. The same process is now successfully established at Froges (Isère), near Grenoble, France, where it has been developed by the Société Electro-Metallurgique Française. At Froges, as at Neuhausen, hydraulic power is employed for driving the dynamos. The available supply is equal to 800 horse-power, and is partly utilized by two turbines of 300 horse-power each, and a smaller one of 100 horse-power. The dynamos are four in number, each yielding 6,000 amperes of 15 volts, and are worked by the two large turbines. The small turbine furnishes a current of 500 amperes, with a voltage of 65, which is employed for the lighting of the works and the motive power required

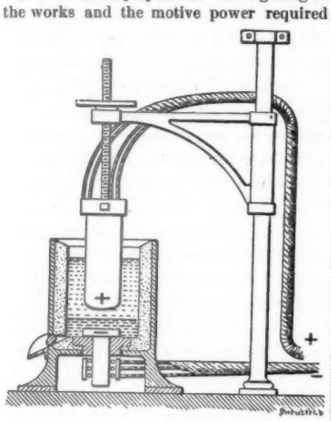

Fig. 2.

for ventilating the foundry and working the smaller machinery.

In the illustrations, for which we are indebted to London *Industries*, Fig. 1 gives a general view of the crucibles in which the fusion and electrolysis of the alumina takes place. Fig. 2 shows the apparatus which is employed for the preparation of pure aluminium. The crucible is raised on isolating supports, and is lined entirely with charcoal. The negative electrode is made of metal, and fixed at the bottom of the crucible, while the positive electrode of carbon is introduced from the top and is capable of being raised or lowered into the molten alumina. The crucible is first charged with a small quantity of cryolite, which soon fuses and allows the current to pass, when electrolysis at once commences, and the alumina can then be added from time to time. The metal accumulates at the bottom of the crucible, and is run off every 24 hours. When pure materials are used, the product is chemically pure, but in practice the precentage of aluminium in the casting varies from 97.5 to 99 per cent. For the preparation of ferro-aluminium and aluminium bronze a somewhat different arrangement is employed, which is shown in Fig. 3. Here, as in the other apparatus, the positive reducing anode is made of charcoal, and is movable. It consists of a series of plates of carbon bound together by copper bands so as to form a solid block about 1 metre in length, with a square base of .25 by .25 m. At C is shown the bottom of the crucible which contains the iron or copper, A, which is gradually converted into alloy by the aluminium as it is produced. The opening in the side of the crucible at O serves to introduce the alumina from time to time and the metal to be alloyed. From it also issues the carbonic acid found in the reaction. At T is a plug of charcoal, closing an opening from which the molten alloy is run at the end of the operation. In work-

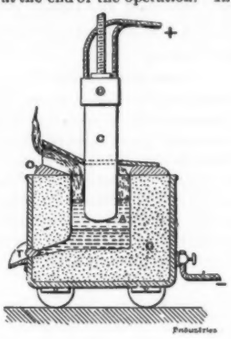

Fig. 3.

ing with this plant the current passes from the electrode C to the iron or copper, and is thus compelled to pass through the layer of alumina. This offers considerable resistance to the passage of the current, resulting in such an elevation of temperature that the alumina is fused to a perfectly fluid liquid, and is then capable of behaving as a simple electrolyte. The aluminium liberated alloys with the copper or iron, forming the negative electrode, and the oxygen disengaged at C rapidly burns up the carbon, forming carbonic acid, which issues from the opening O. This rapid burning away of the carbon electrode necessitates its frequent renewal, but the temperature at A is so high that all other materials are at once melted and thereby rendered unsuitable. The alloys obtained in this way contain from 8 to 30 per cent. of aluminium, and the yield of aluminium is approximately equal to 16 grammes per horse-power per hour. By substituting silica for alumina, the same plant can be employed for the preparation of a copper rich in silicon, from which the different silicon bronzes can be subsequently manufactured.

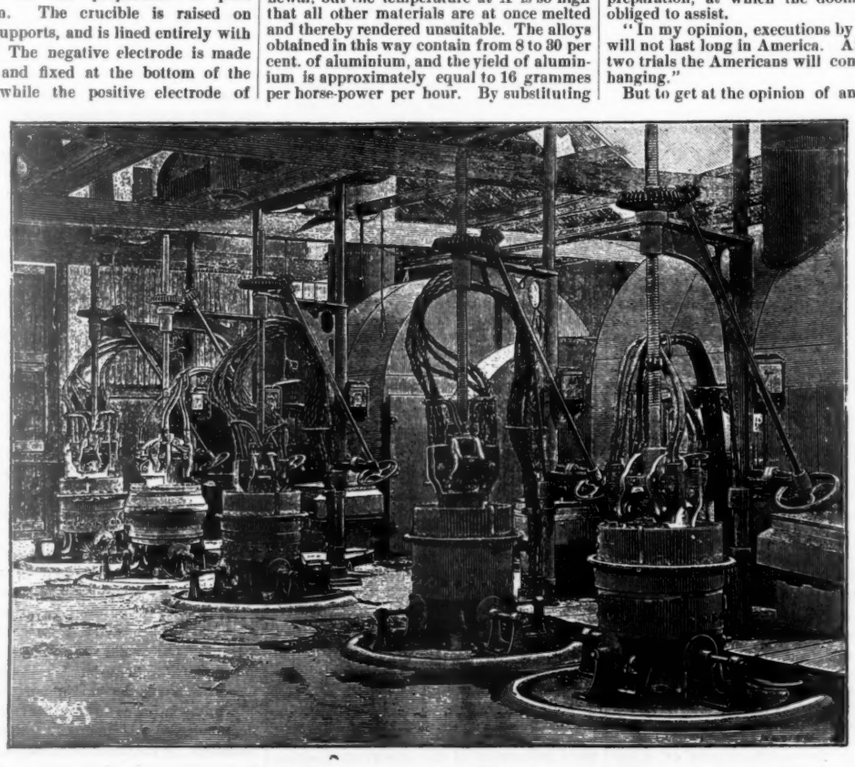

Fig. 1.—Aluminium by the Heroult Process.

—— The Connecticut River Railroad will soon try the experiment of lighting their locomotive head-lights by electricity; storage batteries and 25 candle-power lamps will be used.

Electrocution as Considered in France.

One of the Paris papers publishes an interview with M. Beauquesne, director of the Roquette prison, where criminals condemned to death are confined.

"I am a partisan of the death penalty," said M. Beauquesne; "but the application of that penalty such as it exists seems to me sufficient, and it is needless to aggravate it. Let me explain. Capital punishment by the guillotine is carried out pretty rapidly. From the moment when I go into the cell of a condemned man to announce to him that his application for a writ of error has been rejected and to exhort him to have courage, up to the time when the fatal instant arrives, it seldom takes more than 10 minutes or a quarter of an hour. Now, I am thoroughly convinced, from reading the description of the American system of death by electricity, that this lapse of time must be exceeded. The preparations are necessarily longer and more minute. The patient must be present at them, since the attendants must place him in the fatal chair, bind him, and stretch his legs. That seems to me an aggravation not foreseen by the law. And think of the horrible scenes of resistance that must inevitably occur often. The culprit will struggle. He will not consent to be seated upon the chair of death, and he will be all the stronger because his hands and feet are free until he is in position. Then the executioner and his aids must grapple with him, and a death struggle ensues with the victim. Such scenes are terrible. And when the victim is at last brought by force into the chair, other scenes no less atrocious must follow when the final preparations are being made. Then, again, if in his excitement the executioner forgets some connection, he will turn on the current in vain, it will have no effect, and the whole programme must be recommenced. The authorities have no right either in a legal point of view or in the point of view of humanity to prolong in that manner the agony of a condemned man. I could understand that kind of death if the culprit was not made aware of the preparations beforehand, and if they simply made him step upon a trap where the electric current would kill him. What I do not like in the New York system is the preparation, at which the doomed man is obliged to assist.

"In my opinion, executions by electricity will not last long in America. After one or two trials the Americans will come back to hanging."

But to get at the opinion of an interested party, a man condemned to death, the reporter went to Vodable, the assassin, recently sentenced at the Assizes of the Seine, and made him read the description of the American electric system.

"B-r-r-r!" exclaimed Vodable. "I vote for the guillotine!"

Work on the Kearney, Neb., electric street railway has begun and will be pushed rapidly to completion.

Detroit, Mich.—Parrish Electric Track Signal Company; capital, $1,000,000.

Dillon, Mont.—Beaverhead Water, Light and Power Company; capital, $75,000.

Scranton, Pa.—The Wightman Electric Manufacturing Company; capital, $30,000.

Kenton, O.—Kenton Gas and Electric Company; increase of capital stock from $50,000 to $200,000.

Hamburg, N. Y.—The Hamburg Water and Electric Light Company have increased their capital stock from $12,000 to $50,000.

Chicago, Ill.—Monitor Electric Company; to deal in electrical supplies; capital stock, $50,000; incorporators, G. A. Harmount, N. W. Campbell, John Grant.

Roanoke, Va.—The Roanoke Power Company, with R. L. Gardner as president; to supply power and light to industries, the city, etc. Maximum capital, $250,000.

Chicago, Ills.—Garden City Electric Lighting and Power Company, capital stock, $25,000; incorporators, Charles A. Buell, Douglas V. Bussie, Hosea W. Wells.

Columbia, S. C.—Rock Hill Electric Light Company; capital $10,000. The directors are: James M. Cherry, David Hutchinson, Richard T. Fewell, A. H. White, James F. Reid and Julius Friedbam.

Alexandria, Va.—The American Electric and Manufacturing Company has been incorporated by J. L. Barbour and others; to manufacture telegraph and telephone supplies; capital stock, $500,000.

San Francisco, Cal.—The Electric Vapor Engine Company has been incorporated by Irvine Stuart, Frank E. Temper, John W. Eisenhuth, Robert F. Yount and W. H. C. Fowler, The capital stock is $100,000.

Portland, Me.—The Orient Electric Company; capital, $100,000. President, Robie Blake, Cornish; directors, Robie Blake, Cornish; Col. Edward Moore, Deering; J. J. Gerrish, Portland; treasurer, H. R. Virgin, Portland; clerk, D. W. Scribner, Portland; counsel general, Charles P. Mattocks, Portland.

Binghamton, N. Y.—The Binghamton Electric Company; capital, $200,000. The following are named to manage the business for the first year: George J. Morse, Hyde Park, Mass.; Geo. W. Dunn, Geo. F. O'Neil and John Anderson, Binghamton; W. H Roberson, Harry F. Roberson, Frank Sterry, Albany.

Hartford, Conn.—The Farmington River Power Company; capital, $80,000. Object, to utilize the power of the Farmington River for the generation of electric currents. Following are some of the directors: J. L. Howard, E. C. Terry, W. H. Goodrich, L. A. Barbour, E. B. Bennett, Henry Roberts and Atwood Collins.

Summer Excursion Routes

Under this title, the Pennsylvania Railroad has issued a remarkably handsome pamphlet in magazine form. There are three splendid maps and many wood cuts. The information contained between the tasty covers is vast, complete and reliable. A variety of summer trips is set forth which make a man envious. We have received many similar books but never one so pleasing and withal, so well gotten up. The Pennsylvania Railroad will doubtless be pleased to send a copy to any one who applies for it. Our electrical friends should peruse the pages of this pamphlet before deciding where to spend their vacations.

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We notice that the project of a cable between Spain and Cuba is again to the fore. It is even said that the Spanish Minister of Public Works has now actually invited bids for the laying of such a cable. The subject has cropped up in the Spanish legislature at periodical intervals for the last six or seven years, and even now we doubt whether it is likely to come to anything. The plan is to lay the cable from the Canary Islands (already in telegraphic communication with Spain) to the island of Porto Rico, these being the two points on Spanish territory which would afford the most direct connection. But even so the length of the cable would be in the neighborhood of 3,000 miles, or about 500 miles more than the longest cable (that of the Direct United States Company, which measures 2,565 miles) crossing the North Atlantic. The Spanish government could scarcely hope for sufficient traffic between Spain and Cuba to pay even a fractional interest on the large amount of money that the projected cable would cost, while, from a merely strategic point of view, the game seems scarcely worth the candle, so we consider it is more than doubtful that the scheme will be carried out.

OUR INDUSTRIAL SUPPLEMENT.

With this issue of the ELECTRICAL REVIEW we publish an "Industrial Supplement." We have chosen the manufacture of wire for electrical purposes as our subject because it is an industry to which little attention has been directed by the press and because it stands forth as a bright example of the rapid and wholesome growth to which all branches of the field are subject. The capital invested, the number of people to whom employment is given, the immense production, and the bright and solid men and financiers engaged in the business, all combine to make the wire industry one of the most important and rapidly growing branches of a field whose name stands as a symbol of progress.

The University of Pennsylvania, in their course in mechanical engineering, devote a part of the senior year to electrical engineering. While this is, of course, a great benefit to the mechanical engineers, is not electrical engineering of sufficient importance to warrant the University in establishing a separate course, covering the regulation four years? We rather think it is.

An account of the formation of the Consolidated Electric Storage Company is given in another column. This company has the exclusive franchise to manufacture storage batteries under the Brush patents, as well as others, and is, without doubt, the strongest storage battery company in the business today. The company is firmly started on a strong financial basis and with such a bright and energetic man as Mr. Wm. Bracken at the helm, success ought to be assured. Mr. Bracken states that the storage battery is to be put upon the market in such a way as was never before attempted.

Electricity is evidently becoming every day more popular in England. Judging from paragraphs in late issues in our transatlantic contemporaries, London "Knights of Industry" seem to be turning their attention to electrical matters, but it appears that they are not actuated by any passion for science, because electrical firms find it advisable, after receiving a visit from one of these gentry, to issue a warning note for the benefit of others who may be favored in a like manner. The well-known firm of Woodhouse & Rawson were recently victimized by an individual who took away a goodly invoice of small accessories, leaving in payment a check which was afterwards returned marked "no account." Now it appears that a foreign "scientist" is going the rounds with a statement that he has a valuable invention in the primary battery line, but needs a little cash in order to make up a sample. It seems that at least one firm has furnished this inventive inventor with funds, and others are warned against doing likewise.

The energetic protest against the proposed cable road on Broadway, which was forwarded to Albany last week, contains the following paragraph:

"The cable railway is useful only for communication between points southward of the Harlem River and at comparatively short distances from each other; and the utility of the system for even this comparatively limited use must soon be surpassed by the more convenient electric motors which are daily being brought to public notice."

These remarks might have been couched in better English, but their truth is incontestable; and such a recognition, by men who are in no way connected with the electrical industries, of the important position among the different methods of railway traction which the electric motor has attained in such a comparatively short space of time, will be cordially greeted by all who, like ourselves, believe in the glorious future that electric traction has before it.

The curious part of it is that the signatures to the protest in question are headed by that of the man who has proved himself to be such a bitter enemy of electrical interests; we refer, of course, to the worthy Mayor of the City of New York.

OUR PATENT BUREAU.

Mr. Robt. H. Read, of Washington, D. C., will assume the management of the Patent Bureau of this company, on June 15. While greatly regretting to lose Mr. T. J. McTighe, we congratulate ourselves and the Bureau patrons that we have secured so worthy a successor.

Mr. Read is an experienced patent attorney, a member of the Washington bar, and has made a special study of electrical cases, and in this work has been eminently successful. He is a gentleman of education, ability and progressiveness, and the REVIEW bespeaks for him a sincere and hearty welcome in the wider electrical sphere with which he will now come in contact.

Mr. Thomas J. McTighe, who originated and most ably conducted this department of our business for nearly three years past, leaves with our most cordial wishes for his complete success in the new and very promising manufacturing field he has decided to enter. Mr. McTighe is a gentleman of marked ability, possessed of a force and earnestness that will yet place his name high among the successful men of the times, and it is in no perfunctory sense that we say we deeply regret his departure from our staff.

A LONDON CONTEMPORARY ON ELECTRICAL NOMENCLATURE.

The *Electrician*, of London, in its issue for May 23d, publishes an editorial note on the proposed adoption of "Henry" and "Franklin" as terms for electrical units. Our esteemed contemporary departs somewhat, in the present instance, from its customary serious style in the treatment of scientific subjects, to indulge in a few remarks apparently intended to be facetious. Says the *Electrician*: "We do not wish in any way to deny these eminent men of science (Henry and Franklin) whatever immortality may be conferred upon their names by the decree of some future international electrical nomenclature committee. It will, however, be observed that any attempt to render these names monosyllabic like those of most of their confreres, by the excision of the ultimate syllable, will result in sounds suggestive of ideas quite other than electrical." Judging from the last sentence it would seem that the *Electrician* labors under the impression that most of the terms for electrical units in present use are monosyllables derived by the retention of the first syllable only of the name of the scientist whose memory is thus perpetuated. As a matter of fact the unit of E. M. F. is the only one whose denomination has been derived in such a manner. True, the last syllable of Faraday's name was dropped in adopting a term for the unit of electrostatic capacity, but even the *Electrician* will acknowledge that "farad" is not a monosyllable. It so happened that the names of Ohm, Joule and Watt, were monosyllabic before they were thought of as terms for electrical units, but how about Ampere and Coulomb?

The excision of the final syllable of these names would certainly have resulted "in sounds suggestive of ideas quite other than electrical." In the first case, the cockney electrical man would inevitably speak of "Hams," and would run the risk of being mistaken for a pork butcher, while in the second, it would depend on individual ideas of pronunciation as to whether the impression conveyed was that the weather, or the chimneys, or the dress of monks and friars, formed the topic of discussion; it might even be inferred by some that so many "couls" referred to a liberal number of Summer drinks.

On the whole we think it is pretty clearly demonstrated that if the *Electrician* had no better objection to offer to the proposed new units than that quoted above, it would have done better to remain silent on the subject.

ELECTRICAL PROGRESS IN AMERICA.

In opening the discussion of a paper by Dr. J. A. Fleming on "Professor Elihu Thomson's Electro-Magnetic Induction Experiments," recently delivered before the Society of Arts, Mr. W. H. Preece paid some very handsome compliments to American electricians in general, and to Professor Elihu Thomson in particular. He said that "any one who saw the way in which Professor Thomson did those experiments, or had followed the way in which he had studied and developed the question, must feel that in him England had lost a worthy son and America had gained a great genius, and he did not suppose at the present moment that there was in either hemisphere a more promising electrician. The development of electricity in America made its followers in England feel quite small, and they wondered how it was that they went ahead so fast on the other side of the Atlantic, and why men of talent and ability *would* go there. However, he hoped the day was not far distant when the pockets of capitalists in England would be open as freely to rising electricians as they were in America."

Mr. Preece's remarks, coming from one who occupies a very prominent position in electrical circles on the other side, and who has visited this country on various occasions and is, therefore, fully conversant with the status of the electrical industries on both sides of the Atlantic, will be read with pride and pleasure by all American electricians. At the same time it must be acknowledged that in the concluding sentence of the remarks we have quoted, Mr. Preece has hit the nail pretty squarely on the head. It is undoubtedly chiefly due to the readiness with which capital is always forthcoming for the development of electrical enterprises that that development has been so phenomenal, and that the United States stands so far ahead of other countries in the extent and magnitude of the commercial applications of electricity. It is reasonable to assume that if American electricians had had to contend with the caution on the part of capitalists and the conservatism—not to say downright obstruction—of local and central authorities ("grandmotherly legislation," as a British peer recently put it) that are rife in England, progress would have been as slow here as it has been there.

Yet this very ease with which capital is attracted to electrical ventures, and the extraordinarily rapid development of electrical enterprises consequent thereon, have their dangers and disadvantages, both from a scientific and a practical point of view.

A great deal of the electrical work in this country is carried out in a hasty, unsubstantial manner, without the requisite amount of planning out beforehand and without proper supervision. Companies are organized without difficulty, because the capital is readily forthcoming and the demand for the commodity, electricity, is always present and always on the increase. The chief difficulty is that the industry is so new that there are numbers of men practicing the profession of electrical engineer whose experience, knowledge and ability, are inadequate to the demands made upon them. We have frequently referred to the growing demand for competent, practical electrical engineers, but in too many cases the positions are filled by experts who are so in name only. The result is often evident in slack methods, both indoors and out of doors, bad construction, lack of economy, and unscientific and unpractical work generally. On the other hand, such a state of affairs is not always due to inefficient technical supervision, but very often to absence of any such supervision worthy of the name. Many companies are managed by men who do not appreciate the importance or value of good practical and technical advice, and, knowing but little of technical matters themselves, these wise directors waste annually thousands of dollars of their stockholders' money because they will not incur the comparatively trifling expense of maintaining a good technical staff.

There are many electrical corporations in this country that leave nothing to be desired, both practically and scientifically speaking, but there is still plenty of room for improvement. The good work of the numerous scientific societies, the ever-increasing influence of the technical press, and the growing popularity of college courses of electrical engineering, are doing much to make this improvement more marked every day. Thoroughly trained electrical engineers we cannot have too many of, and the gentlemen who sit around the directors' table cannot learn to appreciate too highly the value of scientific methods and scientific men.

Why He Hustled.

A telegraph operator sat at his desk in the Western Union office one hot afternoon receiving all sorts of messages, and, mechanically, translating the "dots" and "dashes" which the instrument before him clicked off, he wrote the brief communications on message blanks. The melancholy tales of woe, the joyous notes of congratulation, the stories of business troubles, an account of the latest murder, the sensational report of the killing of the New Jersey peach crop, the horrors of the inundation of the Mississippi valley—none of them made any impression on his feelings, and he almost fell asleep over a thrilling account of a terrible storm at sea, says the New York *Tribune*. Two, three, four o'clock arrived, and still the operator drowsily worked away. At 4:30 word was passed around that at the end of the first inning the New York Club had two runs to its credit and Boston none. The operator arouses himself, and just then he began sending messages to the operator at the other end of the wire. Hitherto he had been receiving messages for some time. Another half-hour passed and the returns from the other games began to come in. There was a noticeable difference now in the click of the instrument; much of the sluggishness had gone and the dots and dashes came sharply and rapidly. At 5:30 the man at the other end of the wire broke in and said:

"You seem to be very ambitious to-day. What's the matter? Do you think I am going to work my fingers off for $50 a month?"

The operator at this end did not reply, but just then the results of several games were announced, and he pulled a small piece of paper out of his waistcoat pocket, glanced hurriedly at it as if to make sure that he was not mistaken as to what was written on it, and then went ahead sending messages. He reduced his former speed for a few seconds, but presently he was sending again faster than ever. The man at the other end broke in several times and reproved the fast sender for his speed, and each time he heeded the reproof until further returns were received, and then he would mechanically increase his speed again. As the clock struck 6, the result of the last game was announced, and he again pulled the paper out of his pocket, jumped up and hurried out of the room, muttering, as he did so: "My combination won."

He dined at Delmonico's that evening.

The Court Declines to Give an Opinion.

On the communication from the House requesting the opinion of the Supreme Court whether cities and towns in Massachusetts have the right to make and sell gas and electric light under present laws, an elaborate and respectful answer was returned, declining to give an opinion, for the reason, in brief, that the matter was one of statutory interpretation and the Legislature had control of the statutes. Hence, the occasion was not one which came within the constitutional provision regarding the taking of the opinion of the court.

BOOK NOTICE.

We have received from the Electrician Publishing Company, Chicago, a copy of a neat little volume entitled "Derivation of Practical Electrical Units, by Lieut. F. B. Badt and Prof. H. S. Carhart." Like all the other "Badt" books, this is a good thing. The binding is tasty, the typographical appearance good, the illustrations numerous and the matter contained between the covers is practical and interesting.

CORRESPONDENCE.

OUR BOSTON LETTER.

Mr. Geo. T. Manson, of the Okonite Company, was a welcome vistor at this office the early part of the present week.

The Wainwright Manufacturing Company, of Mass., has removed its offices and salesrooms from No. 34 Oliver street, to the Vulcan Building, No. 8, same street.

Mr. Charles W. Holtzer, of the Holtzer-Cabot Electric Company, met with a painful accident while driving recently, his carriage being run into and overturned. Mr. Holtzer was thrown violently to the ground, and had his hip and side injured, from the effects of which he is rapidly recuperating.

Mr. H. C. Spaulding, manager of the Thomson-Houston motor department, has been elected secretary and treasurer of the New England Electric Exchange, to fill vacancy created by the resignation of Mr. H. H. Fairbanks, of Worcester. Mr. Fairbanks has been elected one of the Exchange directors.

Warren, Mass.—A project is said to be on foot to light the streets and business houses of the above named town with electricity. It is also rumored that the Warren Gas Light Company is among the promoters of the new enterprise.

Rockville Conn.—The recently incorporated Merchants' Electric Light Company has not yet succeeded in obtaining a franchise from the common council of the above town. The Rockville Gas and Electric Company, which has furnished electrics as well as gas for some time past, is determined to keep the field to itself.

Election of Telegraph Officials.—The stockholders of the Bankers' and Merchants' Telegraph Company, of Massachusetts, at their annual meeting in this city, Tuesday June 3, elected the following named gentlemen as directors for the ensuing year, viz: H. J. Pettingill, Dwight Townsend, A. B. Chandler, E. C. Platt and H. De Castro.

Mr. S. E. Barton, president of the Electric Mutual Insurance, of Boston, left Thursday for an extended business trip through the Southern states. It is expected at the company's offices that Capt. William Brophy, chief inspector, will return from his Western trip either to-day or on Monday.

Prospective Electric Light Enterprise.—Parties interested in the Housatonic Water Company, have been prospecting in the vicinity of Stevenson, Conn., with a view to erect a dam across the Housatonic River, to create a reserve reservoir to be available in case of a drouth, and also to facilitate the establishment of the contemplated electric plant and other industries on the north side of the river at Shelton, Conn.

Thomson European Electric Welding.—The annual meeting of the European Welding occurs June 11, at Portland, Maine, when officers will be elected for the ensuing year. European Welding was not traded in during the week until Thursday, when it sold as low as 110. It opened June 6, at 112 and closed at 112.

Salem, Mass.—It is rumored that Mr. Benjamin Orne, of New York, will succeed Mr. Charles Odell as president of the Naumkeag Street Railway. The company has decided to erect a power station on the plot of land known as the circus grounds. The Willow's division, which was run by electric propulsion in 1888, is to be put in shape at once and equipped with all the necessary electric appliances.

Brockton, Mass.—Advices June 3, from the above city to the Boston *Daily Advertiser*, state: The electric plant at this place supplies about 150 motors scattered throughout the shoe factories, stores and shops. It also supplies current for the electric railway, beside 110 arc lights and 500 incandescents. The equipment is a 150 horse-power dynamo for the motors, three arc light machines and two incandescent dynamos. The station is the best protected against accidents in the way of fire and induced lightning of any like place in the country, and this is proved by the fact that the rates of insurance are placed lower than those of any other station.

Additional Electric Cars for Brookline, Mass.—Mr. D. W. Hyde appeared before the Brookline selectmen last evening on behalf of the West End Street Railway for permission to build a power station on Chestnut Hill avenue. He said that there was an electric car running to Boston now every 7½ minutes and that the travel demanded one every five minutes; that a year from now it would require one every 3½ minutes. To get increased facilities for the people the company must have a power station located in Brookline.

Electric Stocks.—Boston quotations at closing hour of the Exchange, Saturday, June 7, were as follows:

Thomson-Houston Electric Company	68¾.
" " " " Preferred.	26½.
" " " " Series C..	17.
" " " " Series D..	8¼.
Thomson Electric Welding Co	225.
" European Welding Co	112.
Westinghouse Electric Co	41.
Fort Wayne Electric Co	131½.
Lynn Gas and Electric Co	150.
Edison Phonograph Doll Co	3¼.
Western Union	85⅞
TELEPHONE:	
American Bell	235.
Erie	44½.
New England	59.
Mexican	1.05
Tropical American	1.25
National Tel. Mfg. Co. (acoustic)	.65

Boston, June 7, 1890. W. I. B.

OUR CHICAGO LETTER.

The Detroit Motor Company, through their Chicago agent, Mr. W. S. Armour, have closed a contract to furnish seven motors to the Columbia Theatre, aggregating 23 horse-power. The motors will be used in furnishing power to the elevators and for small ventilating fans.

Personal.—Mr. Geo. Fisher, of Detroit, Mich., was a recent visitor in the city.—Gerald W. Hart, superintendent and assistant general manager of the Edison Electric Light and Power Company, of Kansas City, Mo., stopped in Chicago recently while on a business trip East.

The Washington Street Tunnel, which has been undergoing repairs for some time past, was thrown open to the public on Wednesday last, and was brilliantly illuminated by 50 Sperry double carbon lamps.

A step will soon be taken by the stockholders in the Whitefish Bay Railway to secure a franchise for an extension of the road, and if secured electricity will be used as the motive power. There is little doubt but what the franchise will be granted, in which case, immediate preparations will be made to build and equip the road at once,

On Monday last the trolley wires of the Hinsey Electric Railway became crossed with the telephone wires, burning out the cable containing 200 wires and shutting off connection with that number of subscribers. Three switchboards in the central station were also burned out. This is the second time it has occurred, and damage suits will at once be instituted against the Hinsey Electric Railway Company.

The Peoria Gas and Electric Light Company was incorporated this week with a capital stock of $750,000. The following gentlemen are among the incorporators: F. C. Crowley, Marion Pickett and W. C. Bain.

The Quincy Gas and Electric Light Company, at Quincy, Ill., has been incorporated, and will construct and operate an electric light plant. The capital stock of the company is placed at $400,000. The following being the incorporators: F. C. Crowley, Marion Pickett and W. C. Bain.

Chas. H. Cone reports the sale of 5,000 carbon batteries of special design to one concern. D. B. D.

June 7th.

GENERAL NOTES.

Electric cars are run successfully with storage batteries in Buda Pesth.

Fire destroyed the station of the Utica, N. Y., Electric Light Company, last week. Lightning was the cause.

It is reported that the Brattleboro, Vt., Telephone Exchange has been sold to the New England Telephone Exchange, for $45,000.

The Nantasket Electric Light and Power Company, of Hull, Mass., has been incorporated with a capital of $10,000; G. E. Davis, president; Elisha Thayer, treasurer.

The Brockton Street Railway Company, of Brockton, Mass., has had 15 horse-power motors substituted on its electric cars for seven horse-power motors, which were of the early Sprague type.

The Western Union Telegraph Company has filed in the office of the Secretary of State, at Hartford, Conn., a lease of the Empire and Bay State Telegraph Company, for 99 years, from February 28, 1890.

On June 24th, at Nashua, N. H., Mr. Hollon C. Spaulding is to be married to Miss Lucile Brisbine. Mr. Spaulding is the energetic manager of the Thomson-Houston Motor Company, Boston, and is a very popular and progressive young man.

The New York and New Jersey Telephone Company is putting through a new line on the south side of Long Island, between Jamaica and Babylon. Six copper wires are being put up. The long distance instruments will be used at all stations.

The Interior and Underground Electric Insulating Company and Indurated Pulp Industries Company, of Rahway, N. J., has been incorporated. The companies will begin business with $1,000,000 capital. The incorporators and stockholders are John Weaver, of Rahway, and Frank Cochrane and Waldo G. Morse, of New York.

Telephonic News

*** The Milwaukee Telephone Company will try the metallic circuit awhile, before suing the electric railway company for damages.

*** Frank E. Bundy, of Elmira, N. Y., has invented a glass trumpet for a phonograph—something which has bothered the wonderful head of Edison for years. Mr. Edison tried metals of all kinds and had to acknowledge them all imperfect, but Mr. Bundy, after two attempts, has invented a glass trumpet which reproduces the sound perfectly. Mr. Bundy has been in communication with Edison on the subject.

*** The employés of the American Telegraph and Telephone Company are at work in East Grafton, N. Y., erecting poles and stringing wires. The line will make communication possible between Boston and Buffalo. It passes through Greenfield, Mass., runs over the Hoosac mountains to Williamstown, thence across the Taghannic mountains to Petersburgh, through Grafton and Brunswick, and will terminate in Lansingburgh. At the latter village connection will be made with the local long distance telephone for New York city. The company connects at Greenfield with the New England Telephone Company. It is expected that the line will be extended to Lansingburgh July 1. At Lansingburgh connections will also be made for Buffalo.

The Audio-Telephone.

A new telephone has been brought out in England, the characteristic point of which is the mouthpiece. The particular advantage claimed by the inventors of this mouthpiece is that it intensifies the sound waves, and thus renders it possible to carry on conversation in an ordinary tone of voice. The mouthpiece is simply a truncated cone which is clamped on to the telephone. By using an India-rubber ring between the mouthpiece and the telephone, any escape of sound is entirely prevented. The cone is double, the outer cone being perforated with holes, the idea being that the vibrations caused by the sound waves on the interior cone have full freedom and are entirely protected from contact with external substances.

Mexican Telephone Business.

A Boston *Herald* correspondent writes regarding a city of Mexico special which said that the Mexican Telephone Company's contracts with the federal and municipal governments were about expiring, and that French and German companies were striving to enter the field in opposition. The correspondent says: "Whoever sent the dispatch cannot know much of the true situation of the telephone matter in Mexico. The Mexican Telephone Company can doubtless make its own reply to this dispatch and rumor. I simply wish to say that 10 years' experience operating telephone systems shows me that possession of the field in the telephone business is 'nine points,' and the Mexican company to my knowledge, has been operating in that territory and filling all demands since 1882, and, besides, has, I understand, valid patents on the Bell telephone and Blake transmitters, so decided by the courts. Whatever municipal rights are expiring cannot be vital, and are probably for territory reserve the Mexican company does not care to operate. I should not fear French or German competition in Mexico any more than in South America, where all desirable territory is well covered and well protected." Nevertheless, the *Herald* correspondent in the city of Mexico is in a position to appreciate the value of federal and municipal contracts to a telephone company in that city. There is much in a business way in being on good terms with Mexican officials.

Love Messages by Wire.

Said a Maine telegraph operator to the writer, the other day: "You wouldn't think that spoony lovers would resort to such public means of correspondence as the telegraph for the transmission of their sweet little messages of love and devotion, would you? They do, just the same.

"Very often a certain young man in this place, if he does not regularly receive a letter from the future source of his joy and happiness, rushes here with a crestfallen countenance and files a message like this:

"'—— ——

"'My dear, why did you not answer my last letter? Yours, devotedly,

—— ——.'

"Perhaps you don't believe such a message as this was sent, but I would show some of them to you if it wasn't against the rules.

"We fellows on the wire enjoyed quite an amusing incident not very long ago in which Sophia sort of gave away John's brilliant scheme of popping the question by wire. We surmise that this brace of folly's victims had been conducting a correspondence for some time, which the artful John culminated with the following dispatch, which was evidently intended to draw forth an answer to an entirely different question:

"'Sophia:

"'Did you receive my last letter?

JOHN.'

"Sophia, in her ecstatic delight, evidently understood the query in a different sense from that which the ordinary reader of the epistle would, and with joy and exultation depicted in her countenance, she proceeded to the telegrapher's sanctum and left the following to be forwarded to the flower of her affections:

"'John: Yes. How about next Christmas? SOPHIA.'

"This gave the thing dead away, and John was much chagrined when he received it. It accomplished its purpose, nevertheless, and now the couple are soaring in the rapturous realms of double bliss."—*Lewiston Journal.*

The Alternating Mosquito Bar.

In answer to a correspondent inquiring for a non-leaking mosquito bar, the New York *Evening Sun* has the following to say:

"Word comes from Paris of the invention of what may be called the Alternating Mosquito Bar. This consists of a mosquito net made of extremely fine copper wire, woven into a cloth which is strong and, at the same time, almost as pliable as a netting made of vegetable fibre. This net is made in the usual form of a canopy, and falls in shining folds about the bed. In the dome of the canopy hangs a small electric lamp. Wires connect the netting with a weak pile battery placed under the bedstead, and by means of a converter are carried into the lamp.

"This mosquito bar is said to work like a charm. The lighted lamp attracts the attention of every mosquito in the neighborhood, and he comes sailing over, and lights upon the wire canopy. The battery presses the button, and the mosquito does the rest. M. Scherer, the inventor, says that on the first morning after his net had been put into use, his servant took up 3.22 litres, or nearly three quarts, of dead mosquitoes. Their limbs were not contracted, nor was any trace of burning upon their bodies, so that all the probabilities were in favor of their instantaneous and painless death. M. Scherer took special note of the body of a particularly large mosquito, of that savage species which infests Trouville, a little later in the season, and observed that his features were composed and regular, and that traces of a smile could be seen on the face.

"Other advantages are claimed for the Alternating Mosquito Bar. The electrical envelop is said to conduce greatly to invigorating sleep, and the cat will never make a second attempt to sleep on a bed protected by one of these nets. A cat in the household of M. Scherer's brother was heard to yowl loudly one day and was discovered by the servants clinging to the wire curtain with starting eyeballs and every hair erect. When released the cat bounded swiftly from the room and, though coaxed with lobster salad, steadfastly refused thereafter to enter the electrical chamber. It is also stated that three days afterward M. Scherer's brother was reading from an American newspaper an account of the Kemmler case, when the cat humped his back, hissed savagely and fled howling from the house. This is interesting as showing the intelligence of some cats, though without bearing on the advantages of the Alternating Mosquito Bar."

On the Heating Effects of Electric Currents.

BY WILLIAM HENRY PREECE, F.R.S.

The effects of the heat developed in conductors when electric currents are transmitted through them have been the subject of constant investigation on my part since 1878. In 1880, I found that the rapidity with which small bare wires acquired higher temperatures and lost them in air, was so great, that it was possible to reproduce sound and speech by means of the thermo-telephone (Roy. Soc. *Proc.*, No. 204, 1880).

I determined subsequently (Roy. Soc. *Proc.*, No. 231, 1884) the current that raised the temperature of small conductors in air to the fusing point, and proved experimentally, that while bare cylindrical wires of of very small diameter did not follow the $d^{\frac{3}{2}}$ law, this law became rigid for all diameters above one mm.

Papers Roy. Soc. *Proc.*, November 24th, 1887, and March 15th, 1888, dealt principally with the fusing points, and the following table, to which I have added silver, gives the fusing constants for all the metals in general use when bare and exposed in still air. The numbers indicate the current in amperes which is required to fuse a cylindrical conductor of a diameter of one cm. of the material named.

	Fusing constant. (*a*).	Fusing temperature. C°.
Copper	2530	1054
Silver†	1900	954
Aluminium	1873	650
German Silver	1292	1200
Platinum	1377	1775
Platinoid	1173	1300
Iron	777.4	1600
Tin	405.5	226
Lead	340.6	335
Alloy (lead 2 parts, tin 1 part).	325.5	180

I have added the temperature of fusion to each of these metals, and the table means that if we take, for example, a uniform copper wire of 1 cm. diameter, a current of 2,350 amperes will raise it to 1,054 degrees C., and therefore fuse it; and if we take any similar conductor of copper, but of different diameter, d, the fusing current, C, is

$$C = 2{,}530 d^{\frac{3}{2}}.$$

The fusing current of any other material is obtained from the equation

$$C = a d^{\frac{3}{2}}.$$

It seemed natural that these constants, marking such a distinct and well-defined fiducial point, should also enable us to obtain the currents that would raise the wire to any other temperature.

A constant current traversing a cylindrical metallic conductor does work, W, upon that conductor to an amount which is measured per second by the product of the E.M.F., E, at the ends of the conductor, and the current, C, or

$$W = E C.$$

This work appears as heat. The temperature of the conductor is raised. When the temperature of the wire becomes constant, the expenditure of energy in the wire and its dissipation by radiation and convection from the service of the wire, must be equal and constant also. Hence the temperature of the conductor when constant becomes a measure of the work done per second, and therefore a measure of the constant current flowing. The rate of loss of heat per degree per unit area of any surface is its emissivity, e. The value of e depends upon the character of the surface—that is, whether is is polished or rough, clean or dirty, bright or black, metallic or oxidized, painted or coated with some preservative or insulating medium. For the present we will consider an unprotected surface, comparable with the surface when at white heat, and we will call that surface *normal*. Let a current be applied to a given conductor, exposed in still air at atmospheric pressure, until it assumes any constant temperature, T, the surrounding objects being at a lower temperature, T_1; then the total heat, W, which will be emitted per second by the whole surface, S, of the wire to the surrounding objects will be

$$W = e S (T - T_1).$$

Hence $$E C = e S (T - T_1) \quad . \quad . \quad . \quad (1),$$

or $$e = \frac{E C}{S \theta},$$

if we put θ for $T - T_1$ the excess of temperature acquired by the wire.

Hence, we can determine e for any conductor at any temperature by measuring E C and θ.

Putting $E = C R$, $S = l \pi d$, and $R = 4 \rho l / \pi d^2$ (ρ being the specific resistance in C.G.S. units, l the length, and d the diameter in centimeters), (1) becomes

$$4 C^2 \rho = e \pi^2 d^2 \theta,$$

and $$\theta = \frac{4 C^2 \rho}{e \pi^2 d^2} \quad . \quad . \quad . \quad (2).$$

Now, if ρ and e vary together in the same proportion in terms of θ, then $\theta = \kappa C^2$ for any particular wire. That ρ and e do vary together in the same proportion is entirely in accordance with measurement and experiment; and it is interesting to note that it is also in accordance with the researches of Mr. J. T. Bottomley on thermo-radiation (Phil. *Trans.*, Vol. 178 (1887), A, pp. 429-450.) Thus, if we take the table given on p. 443 of that paper, and work out the variation in resistance of a platinum wire (which variation is the same as for copper) by the usual formula,

$$R_t = R_0 (1.0038)\, \theta,$$

we get the values shown in the fourth column:

Bottomley's Researches.				R^t calculated from the formula $R^t = 14.5 (1.0038)^\theta$.
θ	C^2/R J s.		e.	
65°	$9.45 \div 10^4$		$14.5 \div 10^6$	14.5
110	20.52	"	18.7 "	17.2
232	74.7	"	32.2 "	27.3
383	226	"	61.6 "	48.4
740	1468	"	198 "	187.6
900	3218	"	358 "	344.2

If we determine C for any temperature, then, since $\theta = \kappa C^2$, the current C′ producing any other temperature θ' is obtained by means of the equation

$$C' = C \sqrt{\frac{\theta'}{\theta}}.$$

Now, for copper of 1 cm. diameter C = 2,530 for 1,054deg. Thus, if we want to find the current that will raise such a conductor to 13 deg., we have

$$C' = 2530 \sqrt{\frac{13}{1054}} = 281 \text{ amperes},$$

if the surface be equivalent to the assumed normal surface.

Now, since we are dealing with metallic surfaces only, and the normal surface has been defined to be that comparable with the surface when at a white heat, it remains us to determine the co-efficient which shall convert this normal surface emissivity to that of the surface of ordinary wires at low temperatures. This I have done for copper, and the results have been amply confirmed by Mr. Kennelly, in Mr. Edison's laboratory at Orange, N. J., U. S. A.

Taking the normal surface as unity, then

	Surface coefficient.
Bright and polished copper	0.5
Copper, dirty, oxidized, or blacked with shellac varnish	0.6
Copper, well coated with lampblack	1.0

Taking a wire 1 cm. in diameter and calculating from

$C' = 0.5 C \sqrt{\frac{\theta'}{\theta}}$ for bright wire, and $0.6 C \sqrt{\frac{\theta}{\theta}}$ for black wire, we get

5 deg.	10 deg.	20 deg.	40 deg.	80 deg.
Bright	Bright.	Bright	Bright	Bright
P K	P K	P K	P K	P K
87 85	123.2 120	168 169	243 236	350 329
Black	Black	Black	Black	Black
P K	P K	P K	P K	P K
104 104	148 147	201 207	291 290	420 410

N. B.—P means calculated from the formula

$C' = 1265 \sqrt{\frac{\theta}{\theta'}}$ and K means the figures obtained by Mr. Kennelly. A concordance which is very satisfactory.

Now the current, C, producing 1,054 deg., θ, in a bare bright copper cylinder of 1 cm. diameter is 0.5 + 2,530 amperes, and that which would produce a temperature of 10 deg. C, is

$$0.5 + 2{,}530 \sqrt{\frac{10}{1{,}054}} = 123.2 \text{ amperes}.$$

Using both alternating and continuous

currents, it was found that in a copper wire with $d = 0.6956$, θ was 50.3 deg. Now the current, C', that will raise a wire 1 cm. in diameter 50.3 deg. in temperature is

$$C' = 2.530 \sqrt[4]{\frac{50.3}{1,054}} = 552.7 \text{ amperes.}$$

But the current that will raise a wire of a diameter of 0.6956 cm. through the same temperature is

$(C \times d^{\frac{3}{4}}) = 552.7 \times .6956^{\frac{3}{4}} = 320.6$ amperes

or, if the wire be dirty,

$320.6 \times .6 = 192.4$ amperes.

The current actually was in each case 198 amperes.

Time	Increase of temperature of wire. C. Deg.	Current in amperes. Observed.	Current in amperes. Calculated. $C' = 0.6\, C \sqrt{\frac{\theta}{\theta_1}}\, l\, d.^{\frac{3}{4}}$
10.45		454	
11.15	86	454	467·7
12.0	80	450	451
3.30	79	443	448
3.45	78	440	445
4.30	73	429	431
Current stopped; wire cooled. Current put on again at 5.30.			
6.0	38	29	310

A copper conductor, bare and dirty, 20ft. long and 0.415 in. in diameter, was stretched across a room where the air was still, and various continuous currents were transmitted through it. The results are tabulated, and the observed and calculated currents given in the preceding table.

Thus, if we know the current producing any fixed temperature in any cylindrical conductor, we can readily calculate the current required for any other temperature.

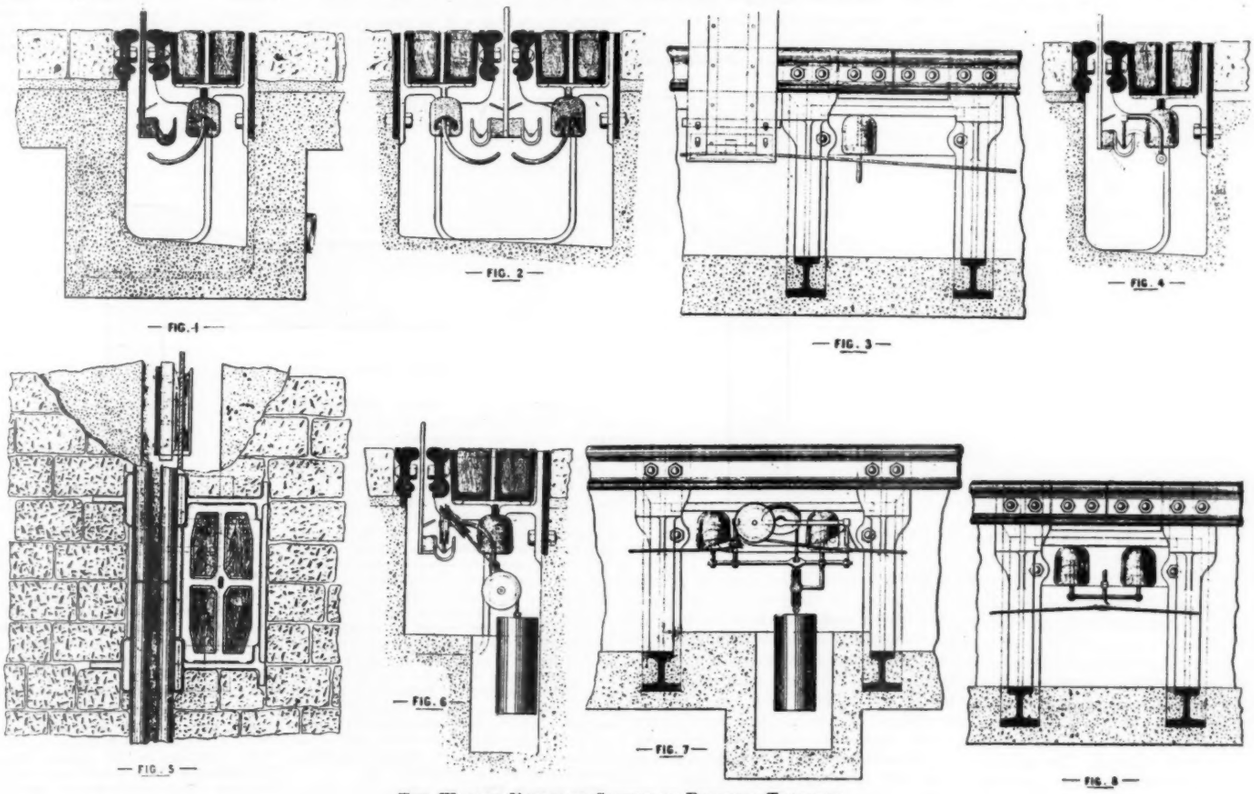
.... The Franklin Telegraph Company held its annual stockholders' meeting in Boston, last week. The following-named officers were elected: Directors, John Van Horn, Norvin Green, Thomas Roche, A. R. Brewer, Joseph F. Greenough, Charles A. Tinker, Thomas T. Eckert, Frederick L. Ames, Jay Gould; clerk, Thomas Roche; treasurer, R. H. Rochester.

.... The Postal Telegraph Company is branching out from Chicago. Last week it created a southern circuit of Western districts, comprising Ohio, West Virginia, Kentucky, Tennessee and Georgia. Major Capers, of the Cincinnati Company, is appointed superintendent, with headquarters at Cincinnati. New lines will be built to Louisville, Nashville, Knoxville, Atlanta, Macon and thence to New Orleans.

The Waller-Manville System of Electric Traction.

There seems to be every reason to believe that Messrs. Waller and Manville, Westminster, have overcome the previously existing difficulties in electric traction in a very practical and simple way, as will be gathered from the above engravings (for which we are indebted to the *London Engineer*) and a description. The essential feature of the invention is the employment of a flexible conductor sufficiently small to permit of its being placed in or withdrawn from the conduit through the slot. The conductor being flexible, the supports may be at long intervals, and can, therefore, be placed in side openings to the conduit itself. By this means space is provided for large and efficient oil insulators. Removable covers are provided to these side openings or hatchways, giving ready access to the insulators. The insulators are mounted in such a manner that on removing the cover they can at once be lifted out. The collecting arm is designed so that the shank can be withdrawn through the slot, and the collector proper, or brush, through any hatchway. Under ordinary conditions the conductor simply rests on supporting arms without being attached thereto. When it is necessary to attach the conductor firmly to its support, as, for instance, on sharp curves, absolute flexibility is still maintained, as the supports are so designed that whilst rigidly resisting either a longitudinal or a lateral strain, the same freedom of upward movement is allowed as in the case of the conductor itself when unattached. Simple automatic apparatus is provided at intervals to maintain a constant pull upon the conductor. The current is collected by means of a U-shaped collector which runs along the conductor; the collector lifting the conductor off the ordinary supports during its travel, and, in the case of those supports to which the conductor is attached, lifting the support itself.

Fig. 1 is a cross section through a hatchway, and shows the ordinary form of curved support on which the conductor rests, and the oil insulator to which this support is attached. The conductor is shown lifted off the support by the collector. Details of the collecting shoe, showing the arrangement for detaching it from the shank, are given in Figs. 1, 3 and 5. Fig. 2 is similar to Fig. 1, but shows the arrangement for two conductors in the tube. Fig. 3 is a longitudinal section through the tube, giving a front view of the curved arm and a back view of the collector. Figs. 4 and 8 give respectively a side and front elevation of a swiveling arm mounted on oil insulators. It will be observed that the conductor is held by this swiveling arm, both being lifted by the collector, thus maintaining the flexibility of the conductor as regards upward movement, while rigidly resisting either a longitudinal or a lateral strain. Fig. 5 is a sectional plan, showing a hatchway. These hatchways would be placed about 30 feet apart. Figs. 6 and 7 show, respectively, a side and front elevation of the tension or straining gear. This consists of a gun metal plate or yoke mounted on two swiveling arms and supported by oil insulators, and provided with small pulleys, so arranged that the conductor, or catgut cord in continuation of the conductor, is led to one side, so that a balance weight can be attached thereto. This weight serves to keep the sag of the conductor between its supports constant in all changes of temperature. As the pulleys are arranged on the swiveling arm, the whole apparatus is free to lift in a similar manner to the single swiveling arm, the conductor being led through an eye in the shaft on which the apparatus revolves, the upward or downward movement of the tension frame in no way affects the length of the conductor, and, consequently, no resistance to this movement is caused by the weight of the counter balance. This tension gear would only be required at long intervals, occurring, say, every quarter of a mile.



The Waller-Manville System of Electric Traction.

H. T. Mannix, of Sioux Falls, S. D., and Harvey Blood, of Aberdeen, were last week indicted for systematically robbing the Western Union Telegraph Company. Their operations have extended over nine years and the amount stolen is reported to reach $50,000. Mannix and Blood are charged with being the leaders of a gang, the others being located at Pierre, Mitchell, Redfield, Millbank, and many smaller towns. The formal charge against Mannix and Blood is embezzlement. Mannix was arraigned and placed under $1,000 bonds. The Western Union Company has discharged its managers in ten cities.

Interesting Relay Signaling.

For some time past a detail of one officer and four men from each army post in the West have been practicing in this Territory and New Mexico in military signaling by means of the heliograph system. From one of them a brief description of the work accomplished was secured.

"The work has been carried on under the direction of Col. Wm. Volkmar, Adjutant-General of the Department of Arizona, and we have accomplished the most wonderful signaling ever known," said this officer. "In our preliminary practice in April we made a connection 90 miles distant, but two weeks ago, in general practice, we did successful signaling from Mt. Reno to Mt. Graham, in this Territory, a distance of 125 miles. This is by far the longest distance work ever accomplished.

"Still more wonderful than this, if anything, however, was our long distance signaling, by means of relays, about 10 days ago. In this case messages were successfully sent from Whipple Barracks, near Prescott, Ariz., to Fort Stanton, in eastern New Mexico, a distance, by the circuitous route followed, of nearly 1,000 miles.

"In this signaling, the messages were flashed from Whipple Barracks to Bald Mountain, thence to Baker's Butte, then to Lookout Mountain, then to Mount Graham, and thence to two or three other small peaks, the names of which I do not remember, into Fort Stanton. In bad weather we went by a much more circuitous route than the one described, being compelled to use a number of intermediate relays.

"The result will undoubtedly be of great service to the army. For instance, troops in the field wanting to communicate with a post 100 miles off would require three to four days of hard riding, by the old system, to accomplish that object. Now, by the telegraph signaling, a message can be sent and an answer received inside of 15 minutes. This will prove especially valuable in case there should ever be another Indian outbreak. In time of actual war it would be of great service. In case of cutting of telegraph lines, messages could readily be sent a distance of 40 to 50 miles, even in the East.—*Arizona Republican.*

* * Memphis, Tenn., is ready to spend $750,000 in electric railways. The mule will go.

* * The adoption of the Thomson-Houston electric motors is becoming quite general in Lowell, Mass.

* * The Somerville Electric Light Company, Somerville, Mass., is improving and extending its lines in West Somerville and Somerville Highlands.

* * An effort is being made at Atlanta, Ga., to organize a company with $600,000 capital to establish a newly invented system of electric motive power.

* * The patience of the public has at last been rewarded by the introduction in St. Louis of genuine rapid transit. John Scullin started his new electric system on the Union Depot line last night, and it's a daisy. It is just as much of an improvement on the cable as the cable is on the horse cars. —*St. Louis Star.*

* * A corporation to be known as the Beacon Vacuum Pump and Electrical Company, capital stock, $1,000,000, has been organized at Portland, Me., for the purpose of manufacturing and selling electric and other machines and vacuum pumps. The officers are: President, Jacob Hillborn, of Boston, Mass.; treasurer, Louis E. Whicher, of Boston, Mass.

* * The managers of the Bridgeport, Conn., silk mill, located in the West End, have decided to place in their establishment an electric motive power plant to take the place of steam power at present employed. The concern has recently purchased 20 new machines, and the managers find the present steam engine of insufficient horse-power to run the entire plant with this extra addition.

* * Charles C. Burton, of this city, has designed a scheme by which he proposes to send an electric car 200 miles an hour. It is to be propelled upon a tubular girder constructed of steel. The car is to weigh 40 tons and carry 40 passengers. Drawings have been forwarded to Washington and a patent applied for. There is no doubt that the idea has a great deal of boldness and originality in its conception. —*Utica Observer.*

* * The authorities of Freiburg, Switzerland, have given permission for an electric power station to be opened in October, for distribution to small surrounding industries. From the waterfall there are 300 horse-power available, two-thirds of which will be distributed for running electro-motors of ¼ to 25 horse-power, and the remainder will be used for electric lighting. The price for motive power to customers is 200f. per horse-power per annum.

* * The citizens of West Orange, N. J., are congratulating themselves that there is every prospect in the near future of having street railroad communication with the outside world. There are three projects on foot covering almost precisely the same ground and one of the three is almost certain to go through. The one that is regarded as the most certain is that of the Essex Passenger Railway, which is backed by a strong following of the residents along the route.

A New Street Car Rail.

The rail shown herewith, designed by R. T. White, of Boston, is for city streets where heavy traffic passes over the rails. More wearing surface is obtained on the head of this rail than on any other form before the flange of the wheel touches the bottom of the groove. Carriages can easily pass over or out of this rail and the groove cannot become clogged as the flange acts as a wedge as it passes along, and forces any stones or dirt up the incline out of the way. The rail is meeting with a popular reception in electric railway work.

An Important New Storage Battery Company.

The Consolidated Electric Storage Company has been organized under the laws of the State of New Jersey. The sole purpose of this company is to manufacture and sell storage batteries. It is called the Consolidated Company, because it is hoped that the other companies who are now in the storage battery business will see it to their interest in time to come into this company, and it is stated that they will all get a fair chance of doing so.

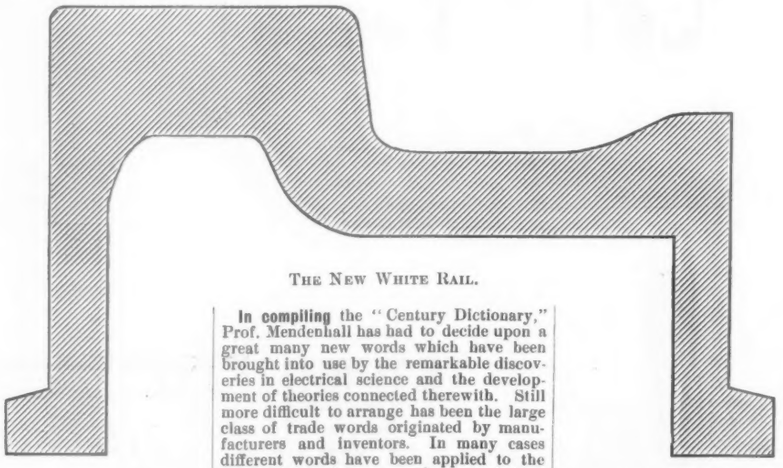
This Consolidated Company owns the Julien storage battery patents, more especially that for the inoxidizable support plate. It owns the exclusive right to use for the whole of the United States, all the Brush storage battery patents and inventions.

The new company will have exclusive license under four patents; Nos. 337,299 and 337,298, which are the broad Brush patents, covering the mechanical application of any absorptive substance of any nature whatsoever to a conducting support; also patent 266,090, which covers a support plate or a conducting support with receptacles, the word receptacles, it is claimed, meaning perforations or any cavity or roughening of the plate for containing material; in fact, any but one absolutely smooth. And also 260,654, which covers the application of oxide of lead to the support plate by pressure. The Consolidated Company owns the mechanical filler patents of Morris & Salom, which cover the process and machine for filling the conducting support or grids with active matter. They are more especially capable of doing this when the active matter is applied in the form of a powder. The two first mentioned Brush patents run 13 years from May, 1889; the mechanical filler patents have about 16 years of life, and the Julien storage battery patent, No. 347,300, being for the inoxidizable support plate, has about 14 years to run.

The Julien Electric Traction Company state that they have sold their cars and everything in relation to traction to the United Electric Traction Company; the United Electric Traction Company having bought not only all the traction interests of the Julien Electric Traction Company, but also all the Daft companies, including the Daft Electric Light Company, with its factory at Marion, N. J., the Daft Electric Power Company, with its three stations in New York, and the Daft Electric Power Company, of Newark, and the Daft Electric Power Company, of Philadelphia. The United Electric Traction Company have also purchased the Chamberlain patent, covering the battery rack, which they report will enable them to dictate to others as to whether they shall use storage batteries for traction. From the Julien Company has been acquired such patents relating to the application of a storage battery to the propelling of street cars as will enable that company to make storage battery traction a specialty; there is, however, we are informed, no understanding, oral or written, between the Consolidated Electric Traction Company and the United Electric Traction Company as to selling the Traction Company batteries or favoring them in any way over and above any others who want batteries for traction. It will be the policy of the Consolidated Electric Storage Company to furnish batteries to everybody on equally favorable terms. It is hoped in that way also to stop infringements, as the new company think they can furnish them more cheaply than any other manufacturers. To show the demand for storage batteries, it may be stated that the Consolidated Electric Storage Company's Camden factory sold last month 1,294 accumulators, although they have not an agent in the field soliciting orders or an advertisement in any paper.

OUR WASHINGTON LETTER.

The Philologists continue their efforts to provide a word to take the place of "electrocution." One authority has suggested electrothanasy, which signifies an easy death by electricity. From this would follow electrothanatism, electrothanatists, etc. Another Greek student thinks a better word would be electroctony which expresses the act of putting to death by means of electricity. The adjective would be electroctonic, and the verb electroctonize. While these words may be constructed on correct principles, they are entirely too long and cumbersome for general use. Prof. Mendenhall, who is the editor of the electrical portion of the "Century Dictionary," has raised the pertinent question whether it would not be better to drop the prefix "electro" and adopt some other more suitable word. Will it not be necessary to have some word to signify *accidental* death by electricity, which will be entirely distinct from that used to express the official killing of convicts?



The New White Rail.

In compiling the "Century Dictionary," Prof. Mendenhall has had to decide upon a great many new words which have been brought into use by the remarkable discoveries in electrical science and the development of theories connected therewith. Still more difficult to arrange has been the large class of trade words originated by manufacturers and inventors. In many cases different words have been applied to the same thing, and consequently some of them have been discarded. An indication of the very careful manner in which the work is being done was shown the other day when a dictionary official called to examine the files of the Review. In an article published in this paper over a year ago describing a new photometer, the word was incorrectly printed "*potometer.*" This word did not escape the scrutiny of the "Century" representative, who has depended on the Review for all the new electrical words, and so the professor was called on to explain what kind of an instrument a "*potometer*" is.

The Census Office has adopted the "Century Dictionary" as the standard authority for use in all business of the Bureau. This will prevent much confusion in the use of electrical terms.

What shall be done to distinguish the typewriting machine from the girl who operates it? A correspondent suggests the use of the word coptograph, or typtograph. Either word would mean to write by means of striking, and being derived from the Greek, would have the advantage of being equally appropriate in all modern languages. A person might get a typtograph, learn typtography, give his spare time to typtographing, produce many typtograms, make typtographic copies without errors, and become an expert typtographer.

A draughtsman named W. E. Wood, employed in the office of the Architect of the United States Capitol, has invented a musical attachment to the Hammond typewriter. Each of the keys is made to close an electric circuit and strike an electro-magnetic bell of suitable tone. Any tune can be played and the musical effect of the instrument is exceedingly pleasing. The electrical device can readily be detached and the typewriter used for ordinary purposes. If it were not for the hostility of the wives of men who need the services of private secretaries, this new invention might come into general use.

Washington, D. C., June 7. G. C. M.

OUR ST. LOUIS LETTER.

All the Arrangements have been made for a telegraphers' tournament, to be held on Sunday, June 8, at 1.30 P. M. It will take place on the third floor of the Western Union building, at 215 Pine street. A record made in ink by a Wheatstone recorder will be one of the features of the contest. It was owing to this fact that Sunday instead of a week day was chosen, the Wheatstone being in use every week day. There will be three classes, viz.: Class A, highest readable speed. Class B, highest speed and best execution. Class C, highest speed and best execution by ladies. There is the possibility of a Class D, for the old-timers. That is for 1865 veterans. The prizes for the first, second and third in each class will be, $25, $15 and $10, respectively. At present a great many have signified their intention of going into the contest, and it would seem that the tourney will be a great success.

Two St. Louisians, Messrs. J. B. Legg and John Niles, have just patented an electric "cable" street railway device. It is to carry the electricity for car propulsion through a conduit, in place of the overhead wire system. The conduit consists of iron tubing, seven inches in diameter, in which are the two copper wires for the positive and negative currents. Communication is made with the car by a slot in the center of the track. The inventors claim that their scheme is perfectly safe and is not half the expense of the overhead wire plant. A company is to be organized and $500,000 employed in bringing the system forward. An early trial on one of the street railways here is contemplated.

Now that the Electric Lighting of the city has proven a success, a difficulty in the shape of designating the streets is troubling the street authorities. No place has yet been determined on, though it looks as though the old gas lamps will be employed for this purpose. Another idea is that of painted signs. This is a good opening for some inventive genius.

Mr. John Scullin, president of the Union Depot line, ran the first motor over the route from the power house to the downtown terminus on the night of May 29th. The distance, three miles, was covered in 17 minutes. This is the first of the invading force on the downtown district, and is but the forerunner to the many lines soon to operate by electricity.

The Thomson-Houston System has been chosen by the Missouri Railway Company, who will proceed to change 13 miles of the road, on the Laclede avenue and Market street divisions, from their present horse power. The contract includes 35 motors. The Thomson-Houston Company are rapidly placing their system on the Southern Railway line. They have most of the poles up, and expect to have the road running by August. The power plant will be where the stables are at present, and the company will operate their line by electricity as far north as Sixth and Market.

The St. Louis Electric Power Company started up their new station on Friday, May 5th.

Suburban.—St. Charles, Mo.: This city was lighted by electricity for the first time on Thursday, May 22d. East Louis, Ill.: Despite the strong efforts of the St. Louis & East St. Louis Electric Railway to obtain a right of way in East St. Louis to the stockyards, their plans were defeated by the city council, who granted the right to the East St. Louis Electric Railway Company. This company is hard at work building their line, which will be in operation by August.

St. Louis, June 4. W. H. B.

SOME PITTSBURGH NOTES.

Electric Traction is all the style here. Several very successful lines are in operation; others in course of construction; still others being incorporated. A recent court decision gives the Duquesne Company a valuable right of way through the East End part—the residences of Frank B. Laughlin, George Westinghouse, Jr., Andrew Carnegie and other well-known citizens. The company, with full confidence in its rights had not waited for the decision, but had gone ahead, and has several miles of track down. The system is the Thomson-Houston overhead, and among the gentlemen interested in it are Chris. Magee, S. A. Duncan and Thomas A. Gillespie.

Another Road is chartered near here to extend from the lower end of New Brighton to the upper end of Beaver Falls, a distance of about eight miles. Mr. J. C. Whitla, Beaver Falls, is just the man to correspond with, Messrs. contractors.

The Faraday Carbon Company has greatly increased its business during the past year and is now compelled to extend its factory, and plans are being made accordingly. There is an immense business in arc light carbons, a constantly increasing demand to fill, and the excellence of the Faraday, under the practical general management of Mr. D. D. Dickey, has won it a place for long life and efficiency second to none.

The Solar Carbon Company is doing an extensive business in a field that is now yielding excellent returns, one that promises greatly to increase in the near future. In the manufacture of carbon brushes for dynamos and motors, this company is probably ahead of all others. The far-seeing eye of Mr. F. B. Laughlin, the manager of the Solar Company, took in the situation—and the orders—and now carbon brushes are being made by his company, I believe, for every system in this country. In battery carbons, also, the Solar is doing a great deal.

Speaking of Carbons, the new Washington carbon is meeting with much success. Some of the stockholders reside in Pittsburgh and are well pleased with the outlook for their investment. All who have tried it speak highly of the Washington carbon, which is handled by Messrs. Holmes, Booth & Haydens, the well-known wire manufacturers of New York and Waterbury.

The Westinghouse Electric Company is doing a tremendous business. The record of orders and the immense factory crowded with men and tools bear ample witness to this fact. Mr. Westinghouse, himself comparatively a young man, has around him a staff of particularly bright, efficient and popular young men, all working in harmony, like members of one family. The names of many of them are familiar to the readers of the REVIEW, including Vice-President H. M. Byllesby, with headquarters in London, but just now on a visit here; Acting Vice-President and General Superintendent Chas. S. Pease; J. S. Humbird, whose title is first one responsible one and then another, and who always proves the right man in the right place; Auditor and Assistant Treasurer W. L. McCullagh, one of the ablest and most reliable of all Mr. Westinghouse's staff of capables; and H. McL. Harding, one of the best men in the electric power field, who left the Sprague Company to join the Pittsburghers, where he will win anew those honors and successes which come when intelligent and professional ideas are given an unhampered field to work in. Mr. Caleb H. Jackson is another right bower, and has become well acclimated to New York, though a regular visitor here. Mr. Jackson is probably an officer in more companies than there are days in the month, and yet he always seems happy, and I presume as many more would not disturb his evenness and tact, which is always at hand.

The Amber Club is the name of a society of some dozen gentlemen connected with the Westinghouse Company. They have a handsome house with extensive grounds away out in the East End, where they live under the care of an excellent housekeeper. The pleasantness of this arrangement will probably cause many of these gentlemen to hesitate long before deserting the Amber to start in married life.

The local lighting companies are all doing good business, the increase of size of plant being the order of the day.

Pittsburgh is Rapidly Growing.—Handsome and substantial business houses are going up in many places, and, thanks to the electric and cable lines, the suburbs are rapidly improving. This city of national banks, more, I am told, than any city in the Union, has every indication of being a prosperous and progressive community.

Pittsburgh, June 5, 1890. C. W. P.

New Isolated Work of the United Edison Manufacturing Company.

The United Edison Manufacturing Company, of 65 Fifth avenue, reports that the electric light business in isolated plants and small central stations continues to grow in a very marked and satisfactory manner. The increase on the sale of dynamos by the cash installations department of the United Edison Manufacturing Company during the month of April this year shows 204 per cent. more than for the corresponding month in 1889, together with a greater percentage of lamp capacity of the dynamos. The dynamos have been installed in all parts of the Union, from the Golden Gate city to small villages in Maine; from New Orleans to the newly settled districts in the far northwestern territories.

The lamp sales have also vastly increased; the percentage of increase for the month of April being 116 per cent. more than for the corresponding period last year, showing that the policy of the company in mounting Edison lamps with bases to fit the various sockets that are in use, thus enabling consumers operating plants other than the Edison to use the Edison lamp, has been a wise one.

The United Company for the past eight months have been gradually getting their business in shape to attend to all construction themselves and to supply their plants with the various materials they need. All construction work for the Edison system throughout the United States and Canada is now done by the company itself under a very comprehensively organized construction force.

The company has also established depots of supplies in Chicago, Denver, San Francisco and Canada, in addition to a New York depot, and now carry in each one of these localities a complete stock of dynamos, lamps, sockets, switches, cut-outs, wire of all various makes, in fact, all materials which are used in connection with electric light and power plants.

This arrangement is said to be proving extremely satisfactory to the purchasers and owners of Edison plants, as the company is now enabled to install a plant upon short notice and is able to furnish any supplies required immediately from stock at a short distance from the purchaser.

It has been accepted generally, we believe, by the electric light companies that the Summer months show an unusual falling off, both in regard to lamp sales and installations. But from the amount of business that is being done and the orders that are being placed with the United Company, there will be an exception to the rule this Summer as far as this company is concerned.

—— The Waltham Electric Clock Company expect to establish a factory at Natick, Mass. They claim that in two years 1,000 hands at least will be employed.

—— A new electric lantern has been designed in Vienna for the use of lecturers and medical classes. By a combination of lenses the magnified image of an object is projected on a white screen in its natural state.

—— The total casualties reported at Police Headquarters and the Coroner's Office, in this city, during the month from March 21, 1890, to April 20, 1890, inclusive, was 339. In the whole list, which includes every accident from a fall to a kick from a horse, there is not one accident or fatality due to electricity.

—— The new dynamite cruiser "Vesuvius" will be put in commission at the League Island Navy Yard, this week, when Lieut. Seaton Schroeder will take command of her. He will bring her around to New York, where she will be fitted out with her electric light plant, and will then go down into the Chesapeake for a series of experiments.

A New Electric Coal Cutter.

The Thomson-Houston Motor Company, of Boston, has put in operation an electric coal cutting machine which has attracted attention from mining men throughout the country. The machine is in practical operation near Osceola, Penn. The plant consists of a seven horse-power steam engine belted direct to a seven horse-power generator. The electric current is conveyed through the mine to the coal cutter by a wire suspended along the roofs of the chambers. The cutter in this case is nearly a mile from the generating plant. A five horse-power motor operates it and is compactly placed on the same bed plate with the machine. The cutter itself consists of an iron frame 24 inches high, 8 feet 6 inches long, 30 inches wide. Nine auger-shaped drills similar to those now used in mining are placed in the lower part of the frame. Between each drill is a steel cutter bar which cuts all coal left between the holes drilled by the auger bits. On the under side of each cutter bar are attached several scrapers which hang loosely and pull all the coal back as fast as it is cut or drilled, keeping it out of the way and making the opening clear. All coal taken out of this cut is coarse and none is wasted.

The height of the cut is four inches. The machine makes two cuts in five minutes, as it is easily handled and needs only to be pushed along the breast by lever bars. The switches and controlling devices are so placed that one man easily operates the cutter. The machine is provided with twin wire cable which is long enough to extend along any ordinary chamber and does away with the need of permanent wiring, except in the headings. A suitable truck is provided for the cutter, upon which it may be carried around the mine with ease. An ingenious device will be provided on future machines, by means of which the motor will pull itself and the cutter off and on the track, as required. The weight of the complete machine is a little over one-half a ton. One strong point in favor of this machine is the readiness with which it accommodates itself to varying hardness of strata. The motors are wound for but 220 volts pressure, so that all danger from high potential currents is done away with. The capacity of the machine is 180 tons of coal per day of 10 hours in a four foot vein. Several improvements on the first machine will be embodied in the regular apparatus which is now being manufactured at the Thomson-Houston Motor Company's factories, at Lynn, Mass.

A Thomson-Houston Circular.

The following circular is issued by Henry A. Pevear, C. A. Coffin, J. N. Smith, B. F. Spinney, C. H. Newhall and S. A. Barton, to the holders of common stock of the Thomson-Houston Electric Company, dated Boston, May, 31, 1890:

The directors of the company desire to notify you that they propose to deposit all their stock with the American Loan & Trust Company under the terms of the circulars of May 26, which have been sent to you, and that stockholders representing much more than a majority of the common stock of the company have agreed to do likewise.

The directors believe it is for the best interest of every stockholder to deposit his stock in accordance with said circulars, and desire to repeat that whatever sale is made of the stock will include all the stock deposited, and that the net proceeds of such sale will be divided pro rata among all the stockholders who deposit their stock.

Not desiring to enter into any arrangement involving the possible sale of all our common stock without giving every stockholder an opportunity to participate in all the benefits to be derived from such a sale, we take this method of insuring each stockholder an opportunity to secure the same terms as those upon which our stock may be disposed of, and thereby to relieve ourselves from all further responsibility as to any shareholders who shall conclude not to deposit their stock in accordance with the terms of said circulars.

—— The Apollo Iron and Steel Company, of Apollo, Pa., has decided to illuminate its works by electricity. The company has been prompted to make this improvement on account of the great increase in its business, which necessitates working at night. The new arc lighting system of the Westinghouse Electric Company will be used in lighting the plant.

ELECTRIC LIGHT NEWS

—— A Philadelphia caterer will introduce a novelty in table lighting next season. He proposes to carry an entire electric plant with him, and do away with the present system of candle lighting.

—— The Batavia, N.Y., Gas and Electric Company are making arrangements to consolidate their two plants and place them under one roof. They intend to buy two new engines, making five in all.

—— The Aberdeen, Wash., electric light company has increased its capital stock to $25,000, and will expend $10,000 in extending the system. This is necessary on account of the rapid growth of the town.

—— Hon. Frank Jones is having the magnificent stone wall about his place at Sorrento, Me., wired for electric lights. At every post there will be an incandescent light which will lend an attractive appearance to the place.

—— Moundsville, W. Va., will have an electric light plant. The Westinghouse Electric Company is about to ship to Moundsville one of its 500 light alternate current incandescent dynamos to fill a recently received order from a new lighting company there.

—— The Electric Light and Power Company, of San Antonio, Texas, has been in operation since 1887, and it was one of the pioneer plants in this country, adopting the Westinghouse alternating current system. The company has lately been obliged to make some enlargements in the plant, and added new Westinghouse apparatus of 850 lights capacity.

—— During the past year Pierre, the present capital of South Dakota, has made the most rapid growth of any young city in the West. At that time she had less than 1,000 inhabitants, now she has 4,000, with electric lights, gas, water system and some fine public buildings. Much Eastern capital is flowing in. Philadelphia parties have just completed three miles of street car line.

—— The Salem Electric Light, Heat and Power Company, of Salem, N. J., after having for nearly three years been running a very successful incandescent plant, has just decided to go into the arc lighting business also, in order to meet the great demand which is made for that method of illuminating. The company has just contracted with the Westinghouse Electric Company for one of its new arc machines.

—— The town of Oregon, in the State of Illinois, is determined to be not behind its sister towns in the matter of illumination. A company has recently been formed in Oregon to go into the electric lighting business, and the new corporation has placed an order with the Westinghouse Electric Company for one of that company's 500 light alternate current incandescent dynamos. No time will be lost in the construction of the plant.

—— The electric plant at Brockton, Mass., supplies about 150 motors scattered throughout the shoe factories, stores and shops. It also supplies current for the electric railway, beside 110 arc lights and 500 incandescents. The equipment is a 150 horse-power dynamo for the motors, three arc light machines and two incandescent dynamos. The station is the best protected against accidents in the way of fire and induced lightning of any like place in the country, and this is proved by the fact that the rates of insurance are placed lower than those of any other station. The entire structure is supplied with the Grinnell automatic sprinklers, and there is also a standpipe on the second floor ordinarily used in connection with the boiler, to which hose may be readily attached in case of fire.

ELECTRIC CLUBS.

THE SUMMER CALM EVIDENT AT ALL THE CLUBS.

New York Electric Club.

The Billiard Room has been removed from the basement to the room on the second floor, formerly used as a lecture room. The old billiard room will probably be used as a *café*. The change will be greatly appreciated by the members, as there is better light and more space around the tables.

Club Dinners are frequently given by members to a small gathering of friends. On this point, the new superintendent of the Club, William W. Stadler, is thoroughly at home, and his efforts have been highly complimented.

Recent out of town visitors were: Jas. Swinburne, England; A. P. Roberts and J. N. Culbertson, Buffalo, N. Y.; Geo. L. Stevens, Boston; Wm. M. Mallett, Rochester, N. Y.; W. B. Pearson, Chicago; H. P. Lucas, St. Paul, Minn.; Geo. F. Calkin and Hugh H. McLean, St. John, N. B.; J. C. Batting, S. L. Thomas, H. C. Borchimer, C. A. Bragg, E. A. Sanderson, Philadelphia.

Mr. James Kempster, a popular member of the Club, who numbers his friends by the hundreds, has recovered from his recent severe illness, which at one time made all his friends quite anxious. No face is more welcome at the Club and none was more missed than Mr. Kempster's during his continued illness.

Now is the time when the human who is fortunate enough to belong to the Electric Club, donneth a thin attire, including a white waistcoat, and hieth himself to the aforesaid Club of a hot evening. Here he meeteth up with other congenial spirits of a like bent of mind. He sayeth, "They are upon me!" and straightway proceedeth to order cooling lemonades, which he sippeth with his friends. Thus is many an hot evening frozen out, and the thermometer's futile attempts to float off with the wall pass unnoticed.

The Political Club.

In South Boston, last week, an individual calling himself Dr. H. L. Bowker, delivered an address before a ward political club, on "Street Transportation." Dr. Bowker spoke for an hour "and was frequently interrupted with applause." He took occasion to condemn the electric motor system which, he said, "was conceived in sin and brought forth in iniquity." He declared that the present system of propelling street cars by electricity in Boston was an absolute failure, and that the great cost of maintaining it would sooner or later ruin the West End Company. What are we to do with this sort of animal? How does it happen that the officers of the club allowed this individual to proceed with his blasphemy and abuse? Is it possible that the whole affair had a political significance? For the good of the country, keep electrical development out of politics. As for Bowker—well, he will probably be caught and caged soon and relieve us of the necessity of giving him free advertising.

Will Meet at Detroit, September 9th.

The executive committee of the National Telegraph Exchange Association, to whom was referred the fixing of the date for the next annual meeting, have decided that it shall commence on Tuesday, September 9th, next. The place, of course, will be the city of Detroit, Mich., which was selected by the Association itself at the Minneapolis meeting. The hotel selected as headquarters, and other details of the arrangements for the convention, will be announced later.

A $10,000 Thermometer.

The most expensive thermometer in this country is in use at the Johns Hopkins University. It is known as Prof. Rowland's thermometer, and is valued at $10,000. It is an absolutely perfect instrument, and the graduations on the glass are so fine that it is necessary to use a microscope to read them.

Telegraphs.

According to a writer who has taken the trouble to hunt up the statistics of this branch of business, there are in use now throughout the world 2,500,000 miles of telegraph wire—enough to surround the world with 100 strands.

Of the sum total of lines, those of the United States constitute a little more than 30 per cent., and our mileage is increasing more rapidly than that of any other country on the globe. Sixty-one per cent. of the telegraph lines of the world are owned and operated by governments. Leaving this country out of consideration, about 88 per cent. of the remainder is under the control of governments; or, leaving the United States and Canada out, fully 95 per cent. is owned by governments.

As to the charges for the transmission of messages, they vary greatly. It would be supposed that in the United States, the birthplace of the electric telegraph, the tariff would be lower than elsewhere, but it is not. In North America the body of the message only is charged for; in other countries the address or signature, or both, are tollable. In the United States the toll ranges from 25 cents to one dollar for 10 words, according to the distance; in the Argentine Republic it is 40 cents for 10 words, and 20 cents for each additional 10 words; in Denmark and in Sweden and Norway, 13.4 cents for 10 words, and 1.34 cents for each additional word; in Ecuador, 20 cents for 10 words; in Egypt, 49.6 cents for 10 words; in Germany, 1.4 cents per word, the minimum being 14 cents per message; in the United Kingdom, sixpence for 12 words; in the Cape colonies, one shilling for 10 words, and sixpence for each additional five words or part thereof; in Guatemala, 25 cents for 10 words, exclusive of the address; in Honduras, 25 cents for 10 Spanish words, and double that amount for English words; in Italy, 20 cents for 15 words, and 1 cent for each additional word; in Japan, 4 cents per word, including the address and signature; in Portugal, five cents for the first word, and 1 cent for each additional word; in Roumania, 1.56 cents per word; in Siam, from 35 cents to $3.65 per word; in Switzerland, 1½ cents per word; in Turkey, 2 to 4 cents per word; and in Venezuela, 20 cents for 12 words. In New Zealand messages are classified as urgent, ordinary and delayed, the rates being, respectively, 2 shillings, 1 shilling and sixpence, for 10 words, with a halfpenny for each additional word.

We of the United States do not lead the world in the use of the telegraph, though many think we do. In fact, we fall behind some nations counted as inferior. Within the years 1870–89 the increase in population in England has been 18 per cent., the increase in the number of letters carried, 70 per cent., and the increase in the number of telegrams, 455 per cent. In the United States in the same time the increase in the number of messages was 380 per cent.

A New Insulating Material.

We are able to present the following further particulars regarding the new insulating material invented by Dr. Purcell Taylor, of London, and which was mentioned in a recent issue of the Electrical Review. Writing under date of May 24th, Dr. Taylor states that he has made five varieties, three soft and two hard of the new substance, which is admitted to be artificial gutta-percha. It will not adhere to untinned copper without previous preparation, but when a tinned iron wire (No. 20) was pushed a half an inch into a cake of the substance, it required a pull of 19 lbs. to get it out when cold. The other two varieties are as hard and as black as ebony.

Continuing, Dr. Taylor says: "Mr. Latimer Clark, F.R.S., has favored me with an examination of the material and has pronounced it very suitable, being totally unlike and far superior to the numerous substitutes offered. But he has not himself made electrical tests.

"Wishing to prepare a large quantity for supplying the numerous applicants for samples, I found my present apparatus insufficient, and an accident happened which I thought had spoilt everything. The result proved, however, that I had obtained a very soft and pure India-rubber. It does not soften with heat or become pasty until it reaches 300° Fahr.; it melts and is quite fluid at 350° Fahr. This also squirts readily, but it is rather more difficult to handle than the gutta-percha.

"Buying the materials at retail, I find the price is from two to four cents a pound. It is not too much to argue from this, that the wholesale cost will be two cents a pound. The gutta-percha requires no preparation; the India rubber at present requires to be masticated, but that may, by improved methods, be dispensed with. A curious property of both kinds is that they will not burn in the flame of a lamp, but only when heated to a high temperature in the heart of a fire.

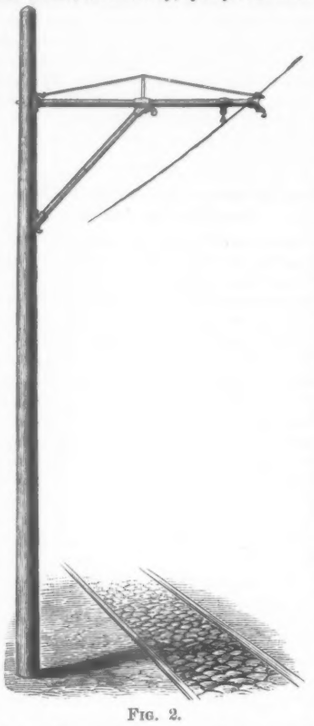


Fig. 2.

"The specific gravity varies from 1.2 to 2.75. Now that I am more expert in manipulating it, I can make it very much lighter than at first.

"Another kind has been obtained having a specific gravity of .8 to .9, but it is scarcely suited for electrical purposes.

"I need scarcely add that not an atom of natural rubber or percha enters into my material. The cost would decide that that were not possible."

Commenting upon this communication, Mr. Henry A. Reed, secretary of the Bishop Gutta-Percha Company, of this city, states that if Dr. Purcell "has what he seems to think, he should get rich. If he has not, he will by no means be the first one disappointed in that direction."

Steel and Iron Poles and Brackets.

Many electric railway corporations and local electric light companies have not been slow to discover the merits of the Walworth poles and brackets, and have shown their appreciation by ordering in large quantities from the Walworth Manufacturing Company, No. 16 Oliver street, Boston.

The first illustration (Fig. 1) shows the Walworth center pole with ornamental brackets, which is intended for electric railway use. This attractive and useful structure has been adopted by several electric railway companies, and has given thorough satisfaction wherever used. Fig. 2 represents the Walworth bracket for use on cedar poles, and is especially adapted for use on a single track electric railway or for electric lighting purposes.

Among the numerous electric railway companies who have in use the above described poles and brackets, are the following: West End Railway Company, Boston, Mass.; Linden Street Railway Company, St. Louis, Mo.; St. Paul City Railway Company, St. Paul, Minn.; Minneapolis Street Railway Company, Minneapolis, Minn.; Short Electric Railway Company, St. Louis, Mo.; Fulton County Railway Company, Atlanta, Ga.; Troy & Lansingburgh Street Railway Company, Troy, N. Y.; Eckington & Soldiers' Home Railway Company, Washington, D. C.; Brooklyn & Coney Island Street Railway Company, Brooklyn, N. Y.; Union Depot Street Railway Company, St. Louis, Mo.; Georgetown & Tenallytown Railway Company, Washington, D. C.; Coney Island Railway Company, Coney Island, N. Y.

The Walworth poles and brackets have been adopted by the Thomson-Houston Electric Company, Sprague Electric Railway Company, Short Electric Railway Company, and many other parent electrical companies. The Walworth Manufacturing Company are also sole manufacturers of a large variety of special tools which are invaluable adjuncts to any engine or dynamo room.

Fig. 1.

The work on the electrical equipment of the Utica & Mohawk Electric Railway, at Utica, N. Y., is being carried forward as rapidly as possible, and it will not be long before the cars will be ready for operation. The motors and line equipment have already been shipped, and the final shipment of station equipment is expected to be made in a few days. Each car will be equipped with two 15 horse-power Sprague improved electric motors, with all the latest improvements and devices used upon any of the Sprague roads.

KINDRED INTERESTS

Mr. George W. La Rue, in addition to his office for the sale of the Sprague electric motors, at 239 Broadway, this city, has opened an office at 38 Mechanic street, Newark, N. J.

The National Galvanic Battery Company, of Cincinnati, have removed from 239-241 Main street, to newer and larger quarters with increased facilities, at 175 Plum street.

The Thomson-Houston Motor Company, Boston, have issued another of their little reference and descriptive pamphlets. The latest one gives information concerning electric tramways for mills and manufactories. Numerous engravings give a good idea of the various uses to which the electric tramway may be put in such places.

The United Edison Manufacturing Company, New York, have sent us a handsome catalogue exploiting all Edison business controlled by the Edison General Electric Company and the Edison Electric Light Company, in North, South and Central America. The cover is handsomely gotten up in white and gold. The cuts and information are very complete, and the testimonials strong and of a recent date.

Atmospheric Electricity.

In the course of four years of experimenting, M. Albert Nodon has established the fact that when the sun's rays fall upon an insulated conductor, metal or carbon, they communicate thereto a positive electric charge, which increases with the intensity of radiations and decreases with the hygrometric state of the air. At Paris the electrification is greatest at about 1 P. M., when the air is clear and dry; but it disappears on the passage of clouds near the sun. The experiments indicate the source, or, at least, one source of atmospheric electricity, as it may be assumed that the surface of the earth becomes positively electrified, while the heated air rises with a negative charge which it imparts to the clouds. This hypothesis would explain many thunder-storm phenomena, including the frequency of such storms over forests, rivers, lakes, etc., where the cooler air causes the electrified clouds to fall toward the earth until a discharge takes place.

What the Electric Bells Did.

In almost every railroad official's private office—say from general manager up—there is a small post near the occupant's desk with a flat surfaced gutta-percha top, in which are imbedded a dozen or more little push buttons. This is the electric call system. The wires run down through the post and branch off to the offices of the various under officials, where they are attached to electric bells or buzzers. They are used by the magnate to call his subordinates to his room when their presence is desired.

A few days ago, a clerk in the general freight department of one of the large railroads was sent up to the vice-president's office with a bunch of correspondence. He was to make some explanations, and, naturally enough, was somewhat embarrassed. While talking he rested the palm of his hand on the flat surface of the post, compressing a number of the push buttons. He felt the little round digits sink under the weight of his arm, and the idea that he had blundered flashed through his mind. He quickly removed his hand and continued his explanation.

Soon the door opened, and the general superintendent walked in, removed his hat and placed it on top of the curtain desk. The vice-president looked up, astonished at this piece of impudence, for be it known that the sanctum sanctorum of the railroad high joint is all that they claim for it in the way of privacy, and is not usually open to callers without the ceremony of a formal announcement by the colored boy in uniform out in the reception room, unless it be by an official summoned by a call bell. While the magnate and intruder eyed each other the door opened again and the purchasing agent tripped in, making a very polite and iron merchant sort of bow, stood with his hands resting on his hips to hear a command from his superior. He was closely followed by the assistant from the chief engineer's office, who was the first to speak. He approached with a red face, and stammered that the chief was out on the line, to which the vice-president replied that he didn't care a —— where the chief was so long as he got the estimates on the superstruction of the Gall River bridge by Saturday, as promised.

"Gentlemen," spoke the high joint, as visions of gold-headed cane presentations flitted athwart the cross beams of his brain, "I don't understand."

The door opened at this juncture to admit two more officials. On their heels was the colored janitor, with two feather dusters thrust on top of his ears as he had seen the clerks carry pencils.

"Yas, sah!" the janitor promptly remarked, as he mingled in the group with a humble courtesy, and mopped the prespiration from his shining forehead with a chamois skin.

"Gentlemen," again began the vice-president, "I have had no notice. I do not understand this. I——"

"Our bell rang," timidly ventured the assistant from the engineering department.

"So did mine," said the general superintendent.

"And mine!"

"And mine!"

"And mine!"

"An' my gong runged as shoh as youh's alibe, sah'!" cried the janitor.

"There is certainly a mistake somewhere," remarked the high joint. "I have rang no bells this afternoon for any of you." The crowd dispersed.

Nobody had noticed the freight clerk, who stood motionless with his face pale as death. He alone could explain, but he didn't. The vice-president touched a button, called in the superintendent of telegraph, and instructed him to examine the wires. Eleven hundred feet of flooring was taken up and replaced, four electricians worked three days each to discover what they afterwards reported did not exist. But the freight clerk was mum.

The Continental Trust and Finance Company, has recently been organized in Philadelphia, with a perpetual charter and $1,000,000 capital. The company has secured offices in the financial center of the city and intends to do a general banking business. Mr. Walter Brown, the president, has associated with him in the directorate other well-known Philadelphians.

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ELECTRICAL PATENTS

Index of Inventions for which Letters Patents of the United States were issued on June 3, 1890.

429,068 Male genital electrode; Agnes R. Sommerville, Chicago, Ill.
429,093 Electric railway. 429,094 Electric motor; Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut.
429,104 Underground conduit for electric wires; Erich L. Witthaus, Baltimore, Md.
429,107 Electro-magnetic locomotive. 429,108 Gear pinion or wheel; Richard N. Allen, Cleveland, Ohio.
429,109 Apparatus for rectifying electric currents; Frank Anderson, Peekskill, N. Y.
429,115 Printing telegraph; John Bumy, Boston, Mass., assignor of one-half to Aloys Wiesching, New York, N. Y.
429,129 Magneto-telephone; Noel B. Ginoclico, New York, N. Y., assignor of one-half to Elias M. Greene, same place.
429,138 Spark arrester; Langford C. Mabie, Richmond, Va.
429,153 Apparatus for the transmission of power; Edwin E. Porter, Canal Fulton, Ohio.
429,172 Portable electric lamp; John H. Irwin, Morton, Pa.
429,174 Wire link cables; Geo. H. Ogilvy, New York, N. Y.
429,199 Electric railway system; William D. MacQuesten, New York, N. Y.
429,233 Multiple telegraphy; Edward N. Dickerson, Jr., New York, N. Y., assignor to the Western Union Telegraph Company, same place.
429,251 Cover for electric subways; John Stafford, New York, N. Y.
429,255 Machine for covering cables; James D. Bishop, New York, N. Y., assignor to James Bassnett Atherton, same place.
429,272 429,274 Electrode for secondary batteries.
429,273 Secondary battery; Carl Heing, Philadelphia, Pa.
429,277 Electric tramway and car; Alexander L. Lineff, Chiswick, County of Middlesex, England.
429,304 429,305 Electric conductor. 429,306 Joint for electric conductors. 429,307 Underground conduit for electric wires; Henry B. Cobb, Wilmington, Del., assignor to the Cobb Vulcanite Wire Company, of Delaware.
429,314 Continuously operated electric motor. 429,315 Insulator for electric railways. 429,316 Tension bracket for trolley wires; William D. MacQuesten, New York, N. Y., assignor to Chas. L. Edgar, trustee, Boston, Mass.
429,318 Electric fire alarm and extinguishing apparatus; Chas. E. Ongley, Yonkers, assignor to himself and Thos. W. Robertson, New York, N. Y.
429,327 Electric railway motor; Frank J. Sprague, New York, N. Y., assignor to the Sprague Electric Railway and Motor Company, same place.
429,330 Electric call and voting apparatus; Tunney M. Wilkins, S. D. Miller, and Axel H. Reid, Glencoe, Minn.
429,333 Process of maintaining a uniform current in electric circuits; Julien M. Bradford, Portland, Me.
429,377 Telegraphy; Shirley M. English, New Orleans, La., assignor of one-half to Alexander F. Wark, same place.
429,396 Electrical clock winding mechanism; Chas. A. Ward, Waterbury, Conn.
429,413 Trolley for electric railways; Warren S. Blauvelt, Asbury Park, N. J., assignor to the Sea Shore Electric Railway Company, same place.
429,447 Medical battery; Franklin P. Hoeneman and William A. Hoeneman, New York, N. Y.
429,478 Interlocking electric railway system; Joseph Ramsey, Jr., and Frederic C. Weir, Cincinnati, Ohio.
429,483 Electric railway signaling apparatus; Chas. H. Rudd, Evanston, Ill., assignor of one-half to James W. White, James Clarence White and Henry M. Lewis, trustees, Philadelphia, Pa.
429,490 Field magnet for dynamos; Edmund Wagemann, Little Rock, Ark., assignor of six-sevenths to John D. Adams, Dean Adams, Oscar Davis, John W. Davis, Horace C. Allis and John B. Jones, all of same place.
429,534 429,535 Manufacture of carbon filaments; Achilles de Khotinsky, Gelnhausen, Prussia, Germany.
429,559 429,560 Electric heating apparatus. 429,561 Electric soldering iron. 429,562 Method of electric heating; Chas. E. Carpenter, Minneapolis, Minn., assignor by direct and mesne assignments to the Carpenter-Nevens Electro-heating Company, same place.
429,573 Electric arc lamp; Chauncy F. Keller, Lima, Ohio, assignor of one-half to Frank Buchanan, same place.
429,576 429,577 Printing telegraph; Andrew T. McCoy, Boston, Mass., assignor to John Anderson, New York, N. Y.
429,581 Apparatus for covering wire with plastic material; Dubois D. Parmelee, New York, N. Y., assignor to the Okonite Company, same place.
429,582 Electric railway signal; Homer A. Parrish, Jackson, assignor to the Parrish Electric Track Signal Company, Detroit, Mich.
429,583 Electrical converter; Gustav Pfannkuche, Cleveland, Ohio.
429,584 Fuse box; Nathan S. Possons, Cleveland, Ohio, assignor to the Brush Electric Company, same place.

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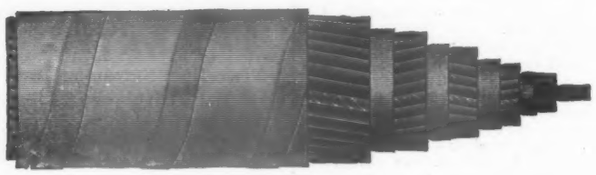

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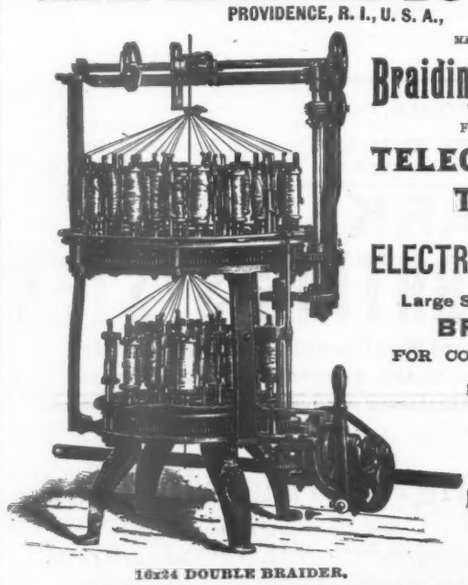

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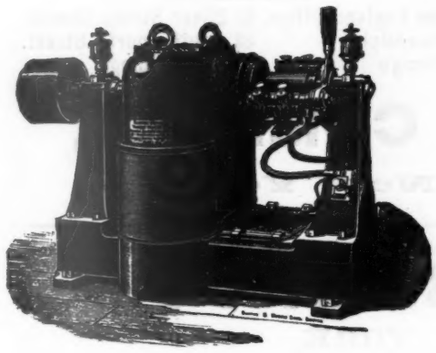

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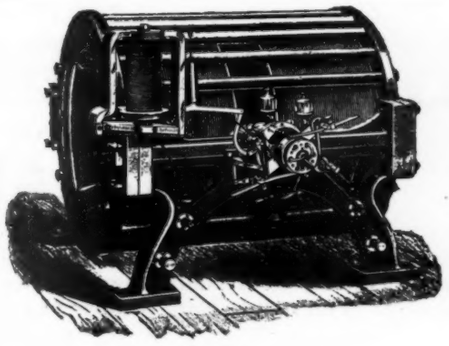

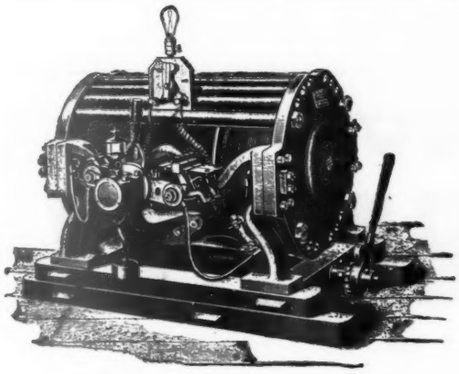

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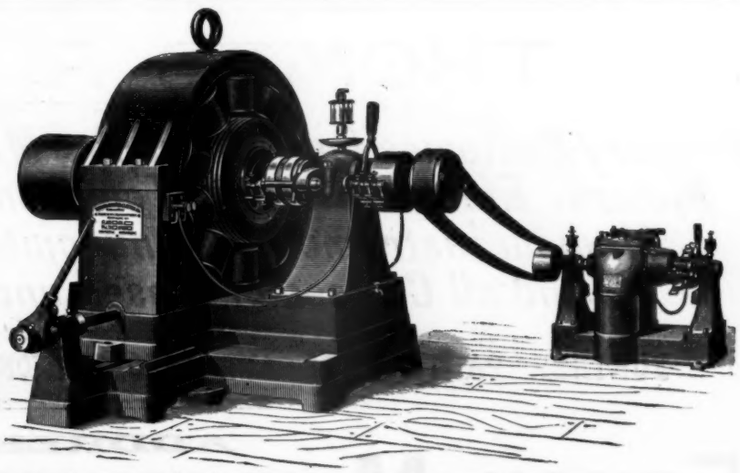

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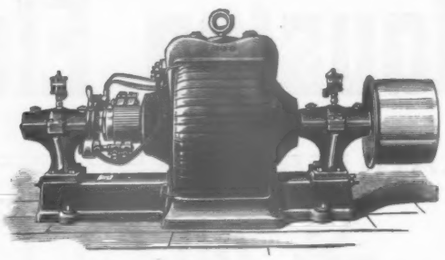

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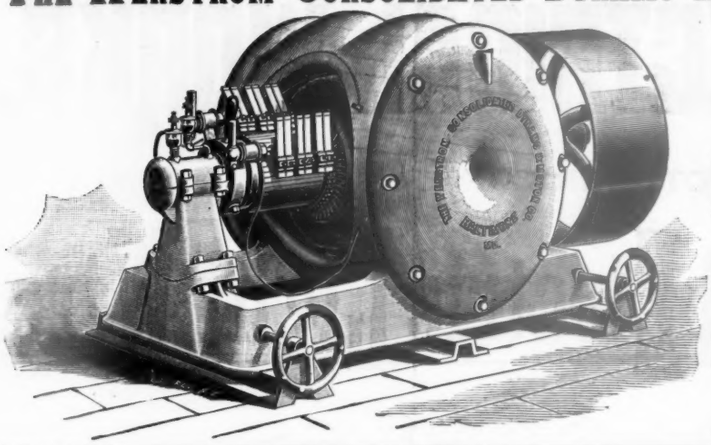

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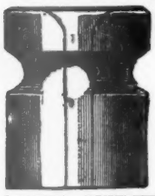

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COLUMBIA	8				6.5	1¼	5,000 FEET PER MINUTE.	530
		10			6.3	1½		530
				25	8.0	2		530
	16				12.0	2⅜		780
		20			12.5	2½		780
			26		13.0	2⅝		780
	20				15.0	3		990
		25			15.6	3		990
			32		15.0	3		990
				50	16.0	3		990
	28				21.0	4½		1,300

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Designation of Machine.	No. Lights 2,000 c. p. 10 amp. X	No. Lights 1,600 c. p. 8 amp. Y	No. Lights 1,200 c. p. 6 amp. Z	No. Lights 800 c. p. 4 amp.	Horse-Power at Pulley of Dynamo.	Width of Single Belt in inches.	Belt Speed Required.	Weight of Dynamo.
CHICAGO		35			21.0	4	5,000 FEET PER MINUTE.	1,360
			45		21.0	4		1,360
				70	21.0	4½		1,360
	40				29.7	6		1,750
		50			30.0	6		1,750
			64		29.5	6		1,750
	52				38.0	8		2,290
		65			38.6	8		2,290
			83		38.0	8		2,290
	64				46.5	10		2,770
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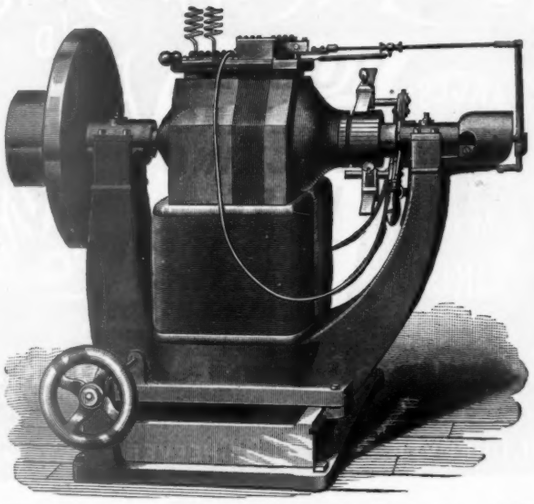

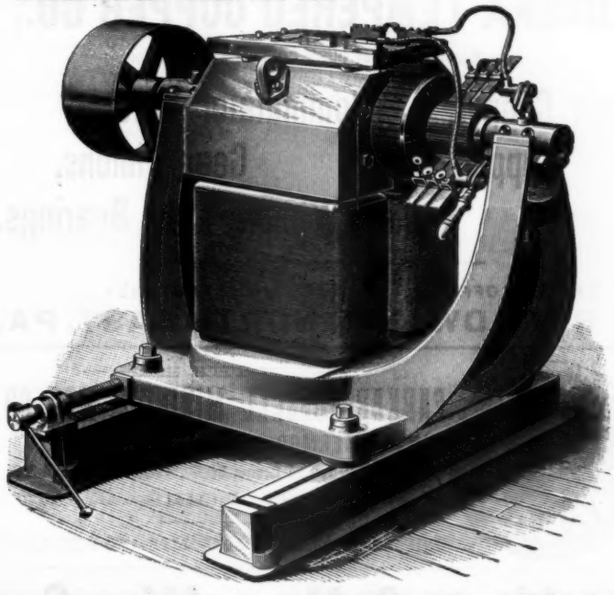

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Fig. 1.

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Fig. 2.

Fig. 3 represents a Copper Sleeve used for straight connections for continuation of cables.

Fig. 3.

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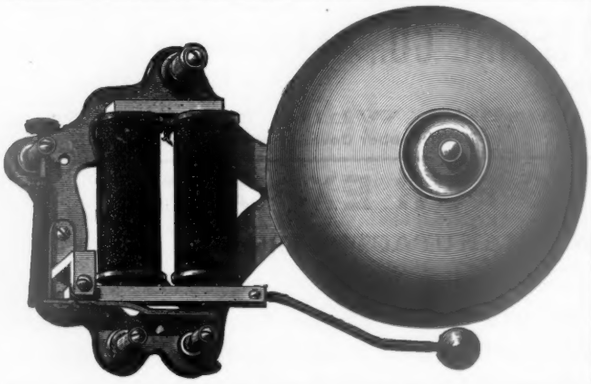

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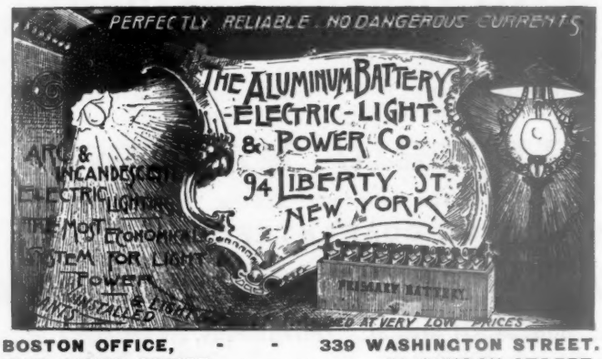

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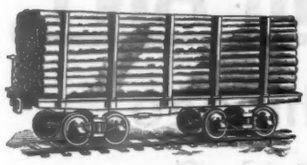

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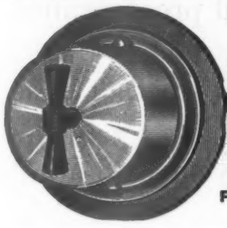

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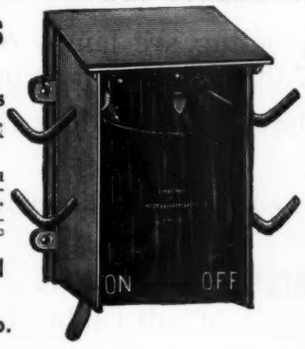

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Against destruction liable to occur by lightning or the crossing of a "live" electric light wire (poorly insulated or broken) with telegraph, telephone or other grounded circuits. Will also take care of instruments used on fire alarms and all metallic circuits.

At the Recent Test before the BOSTON FIRE UNDERWRITERS' UNION, the Cartwright Protector was the only instrument which successfully fulfilled all the requirements, and was approved of and accepted by the Board.

Boston Board of Fire Underwriters,
55 Kilby St., Room 63,
Boston, April 21, 1890.

Electrical Safety Company,
H. E. Townsend, Esq., Treasurer.

Dear Sir: In reply to your favor of this date, permit me to say that the Cartwright Electrical Protector submitted by your company at the recent test of Electrical Safety Devices made by the Boston Fire Underwriters' Union is reported to us as having met in a satisfactory manner all the conditions of the test, and the use of the said Protector will be approved by our Inspectors. I am, yours truly,
(Signed) OSBORNE HOWES, Jr., Secretary.

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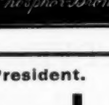
All GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS



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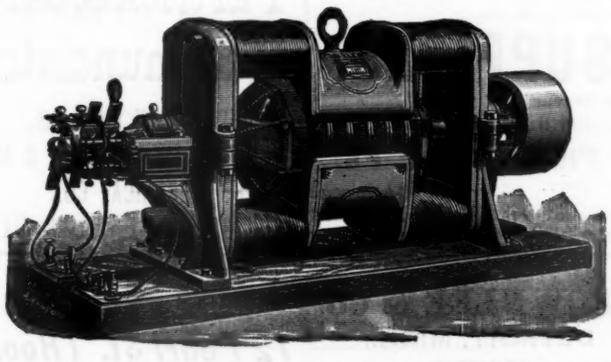

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OR,

An Incandescent Lamp taking a MODERATE and UNIFORM AMOUNT of current, and giving LONG LIFE at its rated candle power

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YOU HAVE NO USE FOR THE FORMER.

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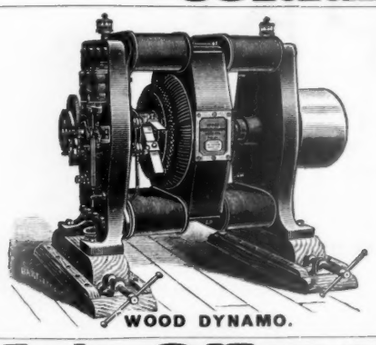

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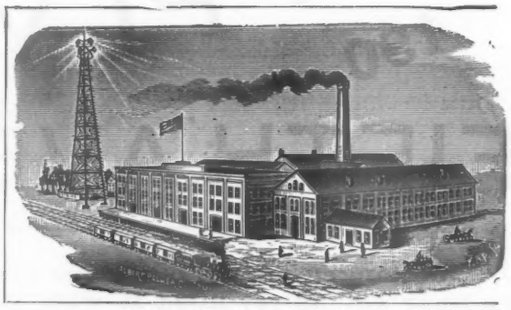

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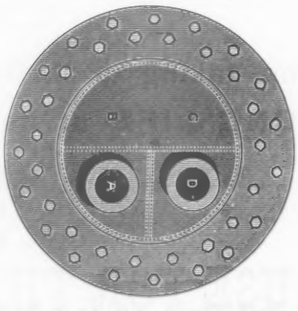

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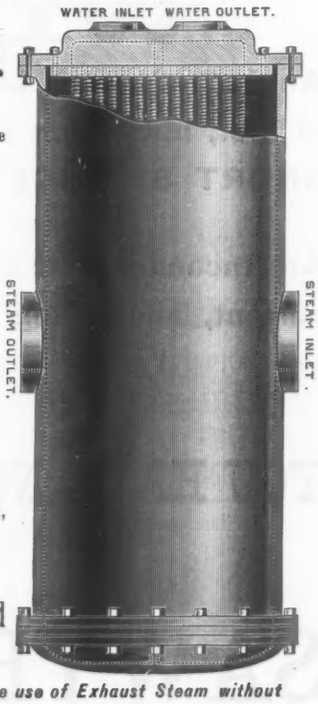

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Electrical Review Industrial Supplement

THE WIRE INDUSTRY

VOL. 16. NEW YORK, JUNE 14, 1890. No. 16.

ELECTRIC WIRE.

A Complete Review of this Important Branch of the Electrical Field.

EARLY HISTORY OF WIRE DRAWING AND ITS PHENOMENAL DEVELOPMENT—INTERESTING DETAILS.

The ELECTRICAL REVIEW, realizing the importance of the wire industry in the electrical field, has, at no little trouble and expense, gathered together for the benefit of its readers the interesting information contained in this

"INDUSTRIAL SUPPLEMENT."

A representative of the REVIEW has personally visited the plants described, and all the figures have been obtained from the headquarters of the firms for which they are quoted.

It is hoped that this series of articles will give to the public and the general reader a just estimation of the real importance of this branch of an industry which is, as yet, comparatively young, and, therefore, not correctly appreciated without the charmed circle. To those directly concerned, we think the information will prove even more interesting and valuable.

ORIGIN AND EARLY MANUFACTURE OF WIRE.

The first American wire drawers learned their trade in England or from Englishmen, but it is probable that the Dutch taught the English the process. We learn from an old encyclopaedia that "the first wire mill in England was set up by a Dutchman, at Sheen, near Richmond, in 1663." This man may have been a wire maker himself, or he may simply have been a builder to whom the establishing of this first plant was entrusted. In England, during the reign of George III, drawers of silver wire were required to pay £2 per year for a license.

"Wire drawing utensils found in any private workhouse, of which no notice hath been given, shall be forfeited." Wire was also subject to a tax and was surveyed by a government inspector.

It is a little uncertain just when the first wire was drawn in this country. Ichabod Washburn, the founder of the present Washburn & Moen Manufacturing Company, made wire in Worcester, Mass., in 1831. In the valley of the Connecticut, wire was drawn at an early date in the present century by Mr. Wallace, whose descendants still carry on the business. Mr. Wallace learned the trade in England. In 1820, Mr. Moore, of Philadelphia, the grandfather of the present Alfred F. Moore, covered iron wire for bonnet frames. This was undoubtedly the first covered wire made in America, but the wire itself was probably imported from England.

At the time of the invention of the Morse telegraph, the

MAKING OF IRON WIRE

received an impetus, and a steady growth in the business followed, as the telegraph was more widely used. The invention of the telephone at a later date, also had a beneficial effect on the wire industry. Within the last 10 or 12 years, the rapid adoption of electric lighting has greatly increased the consumption of covered copper wire. The making of copper conductors may now be said to be the chief branch of the wire making trade, though immense quantities of iron and steel wire are used for telegraph purposes, and for barbed wire fencing and wire goods in general, such as netting and screens, and cables for bridge work.

THE PROCESS OF WIRE MAKING,

broadly speaking, consists in drawing a coarse wire rod through a hole of less diameter than the rod, in an iron or steel plate, and repeating the operation until the rod is reduced to a wire of the required size. The reduction is effected by stretching the wire, and not by removing the metal. At the present day a piece of steel four inches square and three feet long is rolled into a 200 pound coil of No. 6 rods, measuring about 2,046 feet. This rod, by the process of drawing from No. 6 to No. 12, is increased in length to 6,848 feet. The diameter of the No. 12 wire is .105 of an inch, while the billet from which it is made has a sectional area of 16 square inches.

AMERICAN ELECTRICAL WORKS, PROVIDENCE, R. I.

THE POSSIBILITIES OF THE INDUSTRY

are equal to the possibilities in electrical development, for the former may be said to proceed in a direct proportion to the latter, leaving out of consideration the uses of wire in other commercial directions.

The following descriptions of the various plants are arranged in alphabetical order.

The Aluminum Brass and Bronze Company.

The plant operated by this company is located at Bridgeport, Conn., and covers about ten acres of ground. The manufacture of bare wire for electrical uses is one of the most important departments of their general brass business. They are the

ONLY MANUFACTURERS OF SILICON BRONZE WIRE

in this country. The Sprague Electric Railway and Motor Company use this wire for trolley wires on their electric railways. About 300 hands are employed. The works have a capacity for producing about 8,000,000 pounds of wire per year. Besides making wire, they roll sheet copper, sheet brass, and also produce large quantities of aluminum and silicon alloys in sheets and rods and castings of all varieties. The company was organized in June, 1888, and the growth has been exceedingly satisfactory for a new plant. The present demand for the company's products may necessitate an increase in the size of the plant.

The electric lighting plant consists of an Edison 270 light incandescent dynamo and a Sperry 20 arc light machine. All the incandescent lamps used are 32 candle-power.

THE OFFICERS.

Frederick J. Kingsbury is president and treasurer of the company; Frederick J. Kingsbury, Jr., secretary; Dr. Leonard Waldo, electrician; Charles S. Morse, assistant treasurer and superintendent. The New York office is in the Stewart Building, 53 Chambers street, with Thos. L. Fowler as general manager and Samuel B. Hawley as agent. Mr. Fowler was for 15 years connected with and for several years manager of the metal department of the Ansonia Brass and Copper Company and is an energetic and enterprising business man.

The American Electrical Works.

At 67 Stewart street, Providence, R. I., are located the offices and plant of the above company. A block of land, 1,900 square feet in size, is covered by the buildings, most of which are five stories high. The business includes the drawing of bare wire and covering wire for every use to which insulated wire can be put. The wire drawn is from No. 18 down to a mere thread as fine as .002 of an inch in diameter. About

400 HANDS FIND EMPLOYMENT.

A large order, which has just been finished, is that for 15 miles of 100 wire cable for the Metropolitan Telephone and Telegraph Company, of New York. Another order for five miles of 100 wire cable has just been sent to Hartford, Conn. The telephone companies in Boston, Cincinnati and San Francisco have also in use many miles of cable from the American Electrical Works.

As soon as possible it is expected to add another building to the present plant, which will give an unbroken front an entire block in extent. The new building will be 95x36,, and five stories high.

MR. EUGENE F. PHILLIPS

organized the business in 1870. In 1882, the present stock company was formed. Mr. Phillips is one of the best known manufacturers in the trade, and was old in the business when most of his competitors were but just commencing. The first wire made by Mr. Phillips was produced in a barn in a yard back of his residence. The two original braiders which covered this first wire were made by the Rhode Island Braiding Machine Company, and are still in use.

The plant is lighted by a 350 light Weston dynamo.

THE OFFICERS

of the company are Eugene F. Phillips, president, and W. H. Sawyer, secretary and treasurer.

The extensive New York office is at 10 Cortlandt street, under the management of Mr. P. C. Ackerman.

The Ansonia Brass and Copper Company.

This company is one of the oldest as well as most widely known wire manufacturers. Its offices are at 19 and 21 Cliff street, New York city, and its very extensive factories are located at Ansonia, Conn. Mr. A. A. Cowles, the inventor of the Cowles fire proof and weather proof electric light wire, is the active head of the company, and has associated with him a number of gentlemen well known in the electrical field. The company manufactures bare and covered copper wire of all descriptions, and, while conservative in its methods of doing business, has a reputation for good work second to none, and a financial standing that is gilt edged. The company also engages largely in metal work, but its electric wire department is an extensive and growing part of its business.

In addition to offices and warerooms in this city, the company has a warehouse in Chicago, on Wabash avenue, and is the proud possessor of a large Western trade, built up by Agent Smith, of that city.

The Benedict and Burnham Manufacturing Company.

This company is one of the large wire manufacturers in the Connecticut Valley. The plant is located at Waterbury, Conn., and about seven acres of ground are under roof. The manufacture of wire for electrical purposes is an important department. About 860 employés are on the pay-roll. The production of these mills aggregates

SEVERAL HUNDRED THOUSAND POUNDS PER MONTH.

Both bare and covered wire, including line and magnet wire, are produced. This department was organized about 1880.

The capacity of the plant is increased as often as demanded. Two Brush arc 50 light dynamos are used for illumination.

THE OFFICERS

of the company are A. S. Chase, president; E. L. Bronson, treasurer, and E. L. Frisbie, Jr., secretary. The company has depots at 13 Murray street, New York, 24 Oliver street, Boston, and 17 North Seventh street, Philadelphia.

Bishop Gutta-Percha Company.

This company is the original manufacturer of pure gutta-percha goods in this country. The business was founded in 1847, by S. C. Bishop. The covering of wire is a large department in the business. A building 100x100 and three stories high, is occupied at 420–426 East Twenty-fifth street, New York. During the past three months the company has laid 25 miles of electric light cables, both for incandescent and arc circuits, in this city. These cables were covered with the Bishop rubber compound and encased in lead.

OLD CABLES.

In 1847 the first wire was covered. The company has in its possession samples of iron wire run across the Harlem River at High Bridge, in 1847, on which the insulation is still good. This wire was also partly underground and formed part of the Bain Telegraph Company's line from New York to Boston. In 1849, this company put the first cable under the North River. It was made of No. 9 iron wire covered with gutta-percha, having no other protection, and was laid for the American Telegraph Company. This was probably the first submarine cable used in this country. During the war, Mr. Bishop supplied the government and the Western Union Telegraph Company with large quantities of cable insulated with gutta-percha.

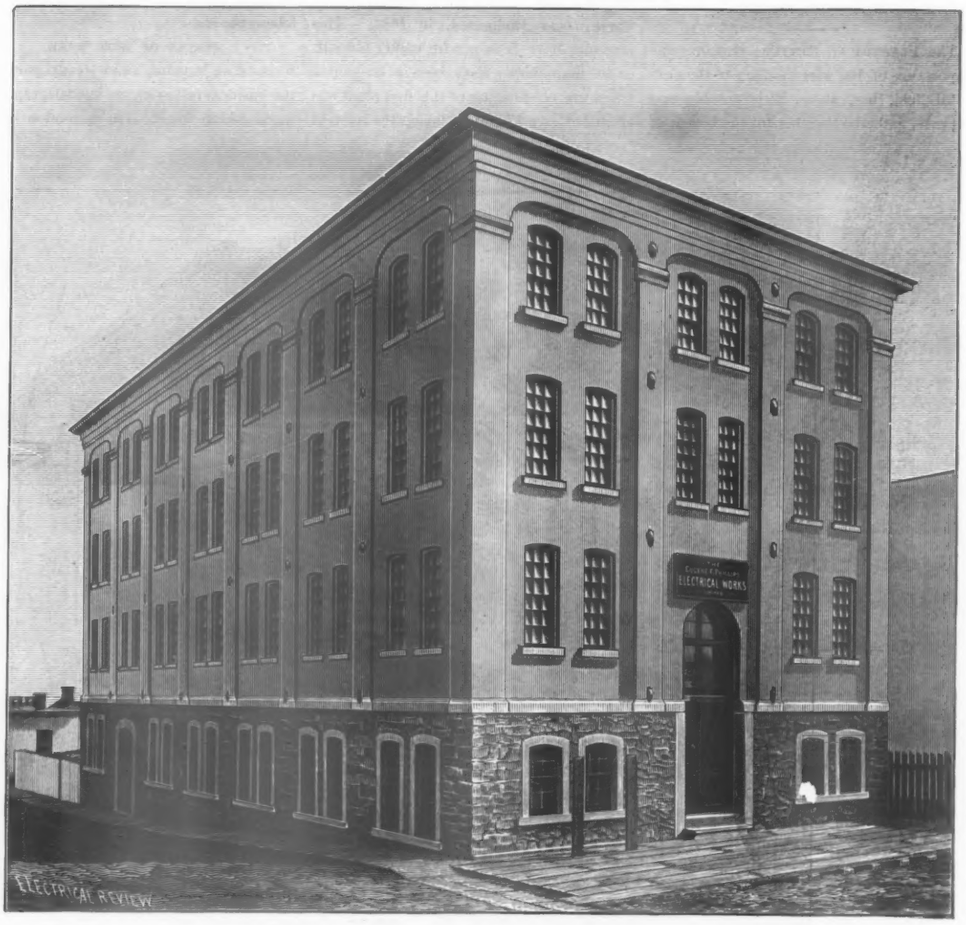
In July, 1885, the present corporation was formed, with Samuel Boardman as president and Henry A. Reed as secretary and general manager.

Up to 1887, the company depended upon gutta-percha as an insulation and still consider it far superior to any other for subaqueous service. On account of its great cost and liability to soften at high temperatures, in 1887, they put in an entire new plant for the insulation of electric light wires after the style of those made for many years by Siemens, Hooper, Henley and others in England, and now generally known in this country as "white core" rubber insulation. They consider it less inflammable and more durable than any other high grade insulation now in use. For sub-aqueous electric light cables they use a coating of pure rubber between the conductor and the white core insulation. This special insulation is also used in wiring the government gunboats.

The new machinery for a recent increase in the size of the plant has cost over $30,000 in addition to machinery which was already in use costing $100,000. The company has a very complete machine shop, and makes its own patterns and special machinery. Several of their best employés, of whom there are 90, have been with them over 30 years.

BALATA.

The Bishop Gutta-Percha Company makes a flexible cord insulated with "balata," a creamy sap obtained from the bullet tree of Guinea, South America. It is flexible, water and acid proof, and does not corrode the wire. It has stood over five years' test without crack or flaw, and is meeting with an extensive sale wherever it is known.



EUGENE F. PHILLIPS ELECTRICAL WORKS, LIMITED, MONTREAL, CANADA.

National Electrical Manufacturing Company.

This is a corporation which has very recently been formed to succeed to the business formerly carried on by the electrical department of the New Haven Clock Company. Temporary quarters are occupied at 187 and 189 Cherry street, New York, as a manufactory, while the commodious offices are at 14 and 16 Vesey street. A large factory fronting 280 feet on the railroad, at Milford, Conn., has been secured and will very soon be operated. All the electrical machinery used by the electrical department of the New Haven Clock Company will be installed there, besides much new and valuable apparatus now being made for this company.

THE SPLITDORF WIRE.

The making of wire is but a department in a general electrical manufacturing business. Wire is made under the Splitdorf patents which are owned by this company, and it is found difficult to make it fast enough for their own use without soliciting or even handling any external trade. The

company is far behind on orders for their special patented flexible cords, which are in great demand.

About 80 hands are employed at present, but this number will be largely increased as soon as the new plant is started. No wire is drawn; bare wire is simply covered, but it is expected that the company will draw wire in the near future.

THE BUSINESS ORGANIZATION.

In 1886 the Splitdorf Wire Company was organized to manufacture insulated wire under the patents of Henry S. Splitdorf. This company has recently been bought out by the National Electrical Manufacturing Company. The officers are: J. F. Tams, president; Charles A. Post, treasurer; J. G. Noyes, general manager.

The offices on Vesey street, are well lighted by incandescent lamps, no gas being used at all. Electric motors furnish power for the lathes on which fine work is done.

The patented spring jack switch cords made by this company are used by the Western Union, and are in great demand. They are said to be absolutely fire and water proof. The tinsel cord is covered with asbestos as well as rubber. This is done by a machine which gets all this extra protection into the same space as that occupied by the ordinary insulation. In making wire by the Splitdorf process, a liquid insulation is applied to the bare wire before a covering is put on. This has been sufficient for use without any covering, some specimens having been in use six or seven years showing no deterioration. The cotton wire made by this process is said to be equal to that covered with silk. This is owing to the fact that cotton fibre is used in the braiding instead of the ordinary cotton. This is done by specially built and patented machines. In fact, it is stated that the Western Union rate this cotton covered wire equal to silk covered wire.

The Bridgeport Brass Company.

As the corporate name indicates, this firm is located at Bridgeport, Conn., the plant comprising over 100,000 square feet of floor space. The making of electrical wires is

AN IMPORTANT DEPARTMENT

in a general brass goods manufacturing business. The annual product is only limited by the capacity of the plant. If the present demand continues, an increase in capacity will be necessitated. Over 600 hands work in the various buildings. In 1865 the company was organized, and in 1882 covered wire began to be made.

The Bridgeport Brass Company were the first manufacturers in this country to make

HARD DRAWN COPPER WIRE,

which has become so widely known and used. They furnished the wire for the first metallic Bell telephone circuit, which ran from New York to Boston. The satisfactory results are well known.

The largest size welding machine made by the Thomson Electric Welding Company is in operation at this plant. A Bell "speaking-tube" telephone, by means of which communication can be had with all parts of the works, is located in the office. There are 20 calls. A private telephone line to the New York store, at 17 Murray street, and complete long distance telephone connections, make the Bridgeport plant very easy of access.

THE OFFICERS.

The president is Charles M. Mitchell; vice-president and treasurer, Fred. A. Mason, and secretary, D. W. Kissam. The Bridgeport Brass Company are sole agents for the Bridgeport Electric Manufacturing Company, whose plant adjoins theirs. The last named company is under the management of Mr. Henry D. Stanley, whose reliable wire tables are continually sought for by all users of wire.

Cobb Vulcanite Wire Company.

This is a company which was formed in 1888 by Mr. Henry B. Cobb, who was a resident of Chicago and is now president of the company. A plant was built and is operated at Wilmington, Del. A specialty is made of underground cables, some of which are in use by the Brush Electric Illuminating Company, of this city. The Cobb Company is a comparatively new organization, and its originator has strong hopes for the future.

A. G. Day.

This company manufactures the well-known Kerite wires and tape. All high grade insulated wires are made, armored submarine cables being a specialty. The factory is located at Seymour, Conn. A very good idea of the plant may be obtained from our illustration. Here every operation in cable making is carried on, including stranding, tinning, covering, cabling and armoring. About 65 employés are retained at the Seymour factory. The New York office is at 16 Dey street, where Mr. George B. Prescott, Jr., is the general agent.

UNDERGROUND CABLES

of the Kerite brand are in extensive use in the Chicago subways. Other Kerite wires are also giving satisfaction in the same city. Nearly all the large telegraph and telephone companies use these wires.

After several years spent in experimenting on insulating compounds, Mr. Austin G. Day, in 1860, produced the compound which he named Kerite. At this time he commenced to produce wire bearing the Kerite brand. The business has prospered steadily, having enjoyed an especially rapid growth since 1878. The capacity of the plant is being increased all the time as fast as necessity demands. The facilities for armoring cables are very complete, and the same may be said of the machinery for covering cable with jute and braiding wires. The plant is illuminated by the incandescent system, current being supplied from commercial circuits. Mr. W. R. Brixie is superintendent of the Seymour factory, and has been serving in that capacity for 12 years.

The Eastern Electric Cable Company.

This firm, maker of the well-known "Clark" wires, is located at 61 and 63 Hampshire street, Boston. The plant comprises four buildings. No wire is drawn, the only product being insulated wires. About 60 hands find employment in the various buildings.

No better idea of the popularity of the wires made by this company can be given than by stating that the business done during the past year indicates an increase of 70 per cent. over that of the previous year. The company has found it necessary to

RUN THE FACTORIES DAY AND NIGHT

to keep up with their orders. As soon as arrangements for additional land can be completed, the entire plant will be duplicated in detail, and, doubtless, many new features will be added.

A 70 light incandescent dynamo furnishes current to light the buildings.

The Eastern Electric Cable Company are constantly receiving

GRATIFYING REPORTS

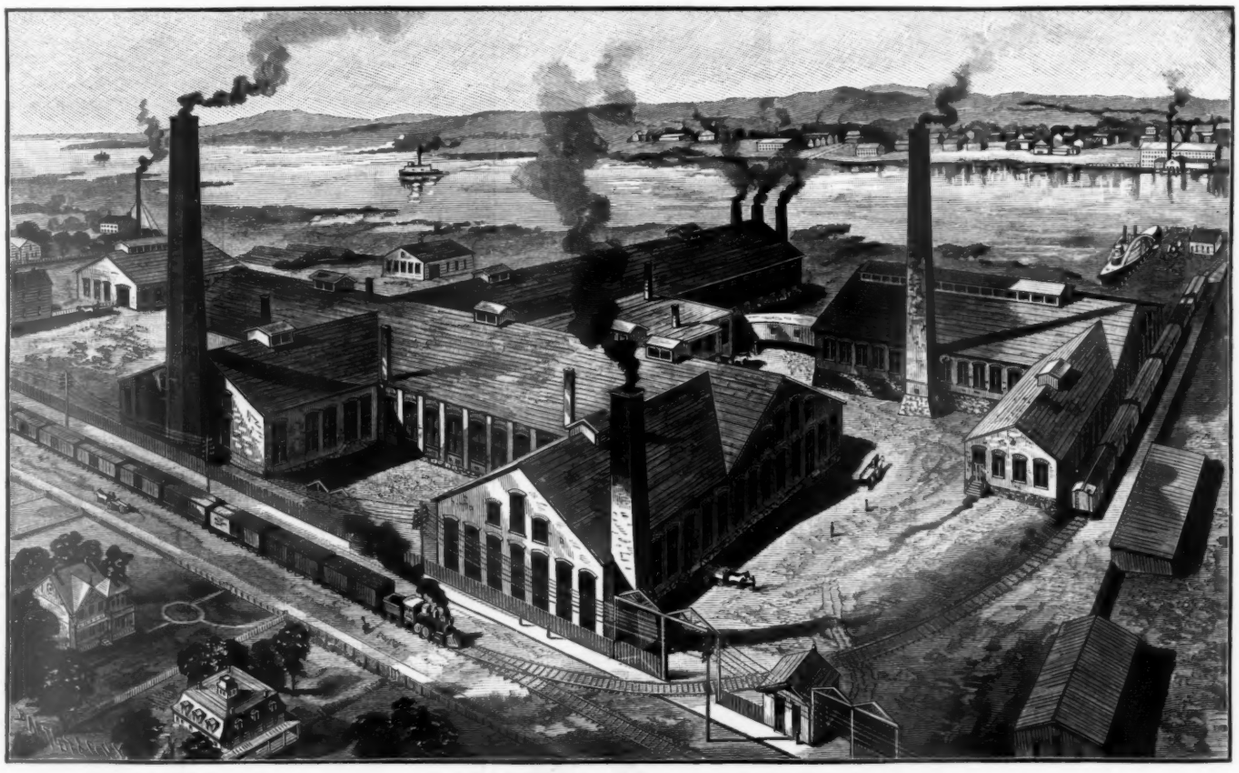
of severe tests and strains which their wires have withstood. A recent report shows that a submarine cable of their make has carried for some time an arc light current of 2,500 volts pressure.

THE OFFICERS

of the company are Herbert H. Eustis, president and electrician, and Henry A. Clark, general manager and treasurer.

Edison Machine Works.

The large Edison Machine Works, at Schenectady, N. Y., numbers among its many productions, electrical conductors.



ALUMINUM BRASS AND BRONZE COMPANY—MILLS AT BRIDGEPORT, CONN.

Two large buildings, two stories high, one 200x60, are devoted to this important branch of the business. Wire is covered only, all kinds being made except underwriter wire. The manufacture of cables will be made a specialty. A recent order is for 70 miles of heavy line wire to cost $50,000. In 1887, this department was added to the business and the growth has been very rapid and satisfactory. Month for month, the business is just double what it was last year.

NEW BUILDINGS.

A very large building is now in process of erection, which will be used exclusively for the manufacture of cables for telegraph, telephone and other services.

This is one of the many consolidated Edison interests, whose officers officiate for all the companies. Samuel Insull is general manager and James F. Kelley, 19 Dey street, N. Y., is the general sales agent.

The shops are all lighted by incandescent lamps, and before long, electric power will be supplied to all the buildings from a power house now being built. A scheme is now on foot, it is said, which will make the Edison Machine Works the largest wire producers in the world.

Our illustration shows the buildings as they appear without the recent additions.

The Electrical Supply Company.

At Ansonia, Conn., is located this company's plant which consists of a main factory, 150x75, four stories high, besides other smaller buildings. The manufacture of wire is a department in the general electrical supply business carried on by this firm. About 200 hands are employed. The business was

STARTED IN 1880

in a room in an adjacent factory. The growth has been very rapid and satisfactory. Plans are under consideration for doubling the capacity of the plant. The offices are lit by electricity supplied from commercial circuits.

THE OFFICERS

are Thomas Wallace, president; L. F. Anschutz, treasurer; Thomas Wallace, Jr., secretary. The Chicago warehouse is at 171 Randolph street.

Empire City Electric Company.

This is a company which is well-known in the general electrical supply business and which has recently put upon the market a wire called the "Helmet" brand. The company's plant is located at New Haven, Conn., in a three story building 125x75 feet, devoted to covering wire. No wire is drawn, the supply of bare wire being obtained from a large wire drawing firm. About 35 hands are employed and 150 miles of covered wire is produced every month.

The factory for covering electrical conductors was begun on January 1st of the present year and by April 1st was in full operation.

RAPID GROWTH.

The company has met with such success in their new venture that a large increase in the producing capacity of the plant is contemplated for next Fall. The factory is equipped with the latest, best and most expensive machinery. Both electric light and power are used.

THE OFFICERS.

Gen. O. E. Madden is president and general manager of the company; E. T. Gilliland and H. L. Storke, vice-presidents; H. G. Madden, assistant general manager, Frederick Lines, secretary, and W. T. Black, Jr., treasurer. Well appointed and handsome officers are occupied at 15 Cortlandt street, New York.

Holmes, Booth & Haydens.

A very widely known Waterbury, Conn., firm of wire manufacturers is Holmes, Booth & Haydens. Their plant covers about 17 acres of ground. The making of wire for electrical purposes is a growing department in their general brass manufacturing business, which was founded in 1853.

ELECTRIC WIRES WERE FIRST MADE

by this firm in 1880-1, in an attic in one of their own buildings. Bare copper wire being their principal production led this firm to commence covering their own wire. Employment is given to 800 hands.

A large electric welding plant has recently been installed.

THE OFFICERS

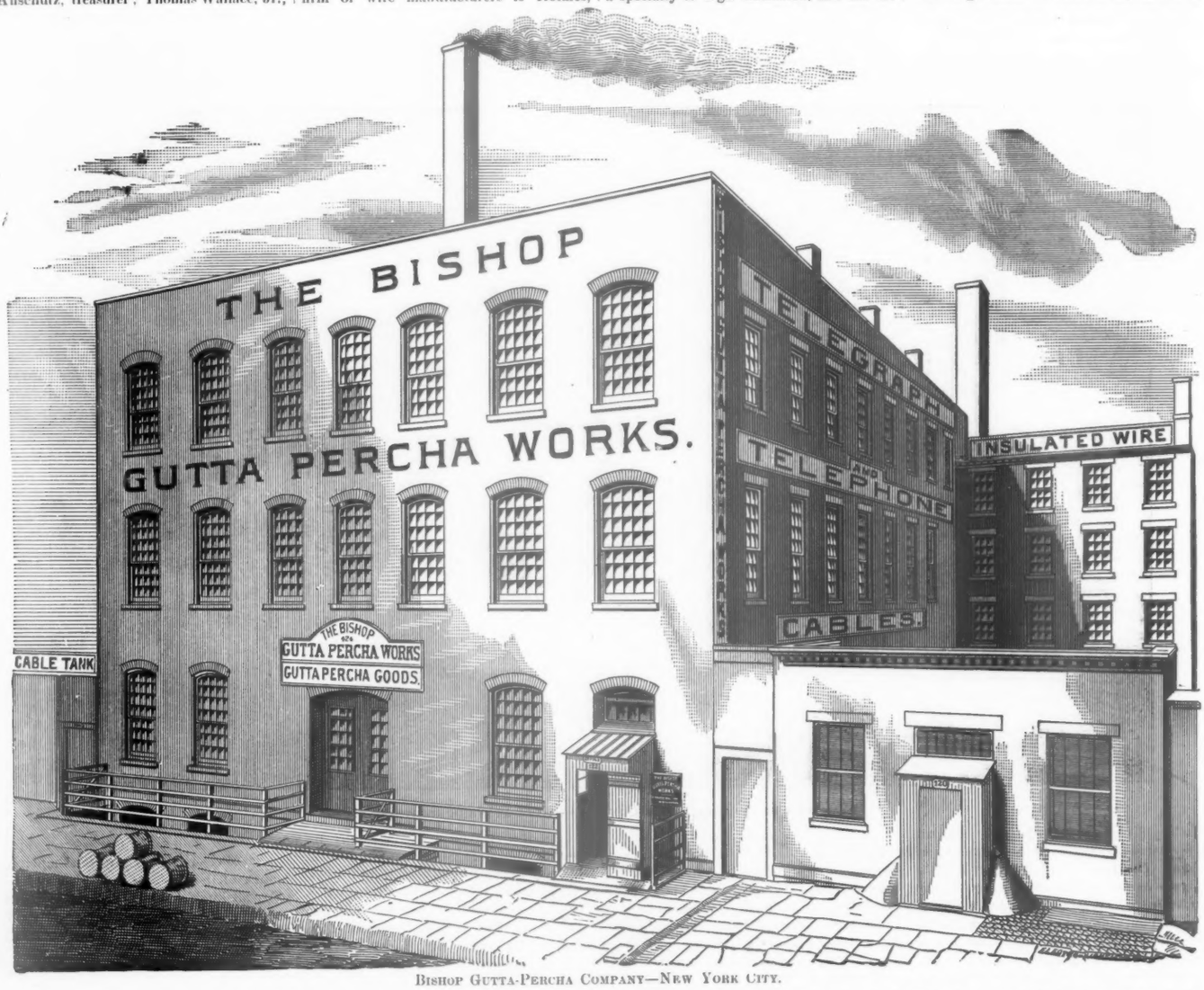
of the company are C. N. Wayland, president and treasurer; Thomas B. Kent, vice-president; F. L. Adams, assistant treasurer; Geo. H. Benham, secretary.

The New York office, at 25 Park Place, is in charge of Mr. Thomas Scovill, a gentleman widely known in metal and wire circles. The New York house is one of the busiest establishments of its kind, and all the different brands of wire made by the company are carried in stock. The patent "K. K." line wire is a special feature of the business of this company, and is largely used by electric light and power companies. Round and flat copper bars for station work are produced in large quantities.

The India-Rubber and Gutta-Percha Insulating Company.

This company's offices are at 159 Front street, New York, and its factory is located at 537 West Twenty-fourth street. Mr. Wm. M. Habirshaw, F. C. S., is the successful general manager. The company makes a specialty of high insulation, and has the reputation of doing first-class work at all times. A great deal of insulated wire has been furnished the Government by the India-Rubber Company.

This company is arranging for an enlargement of its facilities, and will soon be in a position to handle its growing business much more expeditiously.



BISHOP GUTTA-PERCHA COMPANY—NEW YORK CITY.

Alfred F. Moore.

This is doubtless the oldest wire covering establishment in America The house was founded by the present Mr. Moore's grandfather. The plant is located at 200 to 204 North Third street, Philadelphia. Our illustration shows the five story building, which is 160x40 feet. Covering wire is the only business carried on, in which 250 employés are used. The yearly capacity is in the neighborhood of 1,500 tons.

ANCIENT HISTORY.

In 1820, iron wire was covered for bonnet frames. This was probably the first wire covered for any purpose in this country. The first copper conductor was covered by this house, in 1833. Mr. Moore has an old entry book in which the following passage, under 1833, appears: "Covered for Smith and Hodgson, 500 yards 28 copper wire with silk, $1.75."

The Mr. Moore who founded the business made all his own machinery, including the engine which furnished power for the plant. The present factory is the third one occupied, the business having been moved to the present location in 1877. Mr. Moore anticipates making an increase which will double the capacity of the plant. A 200 light Richter dynamo furnishes current for incandescent lamps, and a 125 horse-power Corliss engine drives the machines.

A large stock of wire is carried at 14 Wabash avenue, Chicago, where Mr. G. A. Harmount is the agent. An elaborate catalogue of Mr. Moore's productions, embracing everything from magnet wire to lead covered cables, will be issued early in July.

Associated with Mr. Moore are Chas. C. King and Antonie Bournonville, under the firm name of Alfred F. Moore.

New York Insulated Wire Company.

This firm originated and makes the "Grimshaw" white core insulated wires. The offices are at 651 Broadway, New York, and the plant is located at Wallingford, Conn. The latter is a four story building 306x40 feet. Nothing but high grade rubber insulated wires are made. No wire is drawn. Over 250 hands are employed at Wallingford.

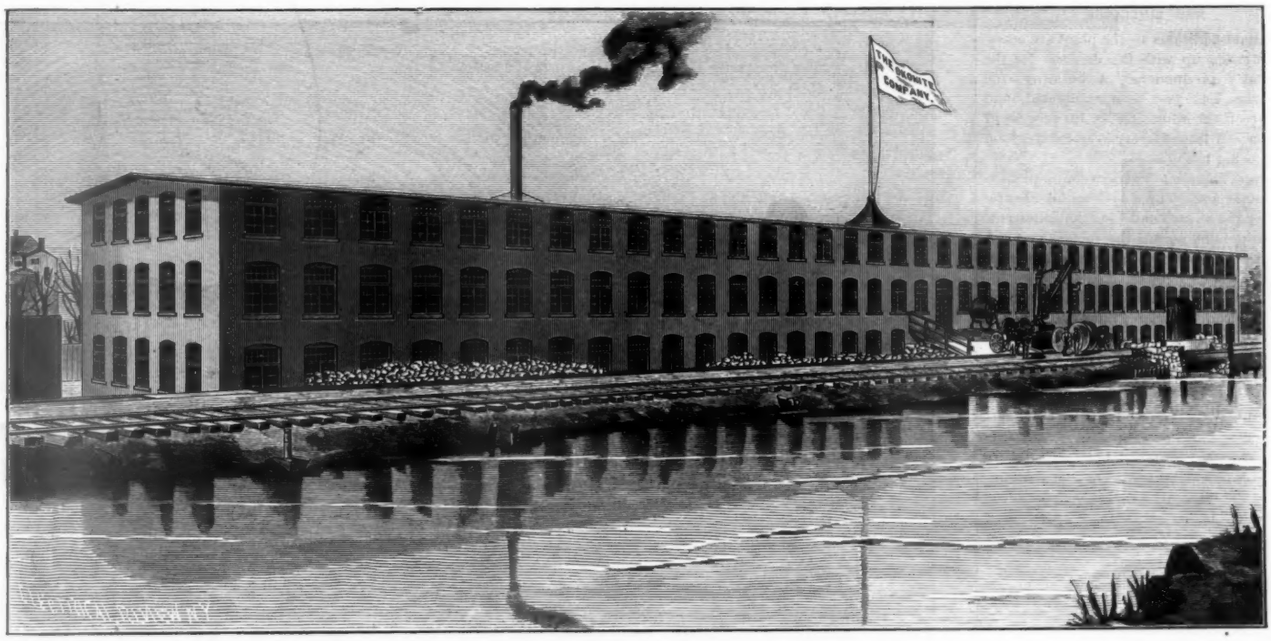
FOREIGN ORDERS.

At present the company is engaged in

shipping an order for 20 tons of their wire to Japan. Another order is for seven carloads to go to St. Louis.

In 1882 the business was founded, and as the factory capacity has been doubled in the last six months, no increase in the size of their plant is at present contemplated. The Wallingford plant is illuminated by a 500 light Thomson-Houston incandescent machine. A spur of the New York, New Haven & Hartford Railroad runs directly into the factory. The business policy pursued has been a conservative one, and the growth has been steady.

The officers are C. H. Wilcox, president; C. A. Place, vice-president; A. J. Tower, treasurer; R. E. Gallaher, secretary; W. B. Dowse, general superintendent; J. W. Godfrey, general manager.



THE OKONITE COMPANY—MAIN FACTORY AT PASSAIC, N. J.

The Norwich Insulated Wire Company.

This company was originally established at Norwich, N. Y., where a large number of cables for the New York and New Jersey Telephone Company were made, five or six years ago. In May, 1889, the present company was formed and the plant moved to Brooklyn. The building at present occupied is 200x60 feet and 60 hands are employed. Nothing but covered wire is produced. About 200 miles of single cable on the average, is made every week. The increase in trade has been rapid and orders are being taken which necessitate the plant running to its fullest capacity. It has been decided to increase the Brooklyn factory to such an extent that the capacity will be more than doubled.

THE OFFICERS

are as follows: Louis D. Beck, president; Anthony Dey, vice-president; J. B. Atherton, secretary and treasurer. The company has been doing splendidly since the removal of the plant to Brooklyn, and has bright hopes for the immediate future.

The Okonite Company.

This is a company which is as widely and popularly known as any other in the land. The name "Okonite" is as familiar to the electrician as the word "wire." A large measure of the company's success is due to the energy and popularity of its treasurer and manager, Capt. Willard L. Candee. The plant is located at Passaic, N. J., in a three story building, 400x80 feet. In addition to this are numerous smaller buildings used for various purposes. Besides making all kinds of wire insulated with the Okonite compound, they make Candee line wire, Okonite tape and two kinds of Manson protecting tape. Every size and kind of wire up to the submarine cable is manufactured, high grade insulation being one of their strongest claims. They employ 460 hands at Passaic, and with an output of 60 miles per day, are still two months behind in their orders. It is not an unusual thing for the Okonite Company to receive single orders for 1,000,000 feet of wire.

GROWTH.

In 1884 the business was founded, and the growth has been simply phenomenal. The Okonite wires, at the time when they were first put upon the market, sprung into a popularity which has been ever increasing. Within a year the plant has been enlarged five-fold, and it is now being run up to its fullest capacity.

The officers are as follows: Charles A. Cheever, president; Willard L. Candee, treasurer; H. Durant Cheever, secretary; F. Cazenove Jones, general superintendent; George T. Manson, deputy treasurer.

Two large Thomson welding machines are in operation at Passaic, and two 500 light Thomson-Houston incandescent dynamos furnish current for illuminating purposes. A special brand of taped Okonite wire for incandescent work is being placed on the market. Other specialties are wire for submarine torpedoes and military wires for use in field manœuvres.

Eugene F. Phillips Electrical Works, Limited.

This company is the Canadian branch of the American Electrical Works, of Providence, R. I. The Canadian tax on covered copper wire is 25 per cent., and the advantage of the American Electrical Works having a branch house in Canada may be readily seen when it is stated that something like $12,000 a year is saved on duties alone. The plant is located at St. Gabriel's Locks, and consists of a building 100x45 and five stories high. Employment is given to 50 hands.

A GROWING BUSINESS

has already been established, although the factory has been in operation but a year. This company has recently absorbed the Dominion Electrical Manufacturing Company, of Montreal. This will largely increase the capacity of the Canadian company.

A large business is being done with both of the Canadian telephone companies, and each month shows a gratifying increase over the previous month's deliveries.

Water power is obtained from a canal. A 100 light Weston dynamo furnishes light for the building.

THE OFFICERS

of the company are Eugene F. Phillips, president, and John Carroll, secretary-treasurer, with Mr. Frank S. Mead, as superintendent.

John A. Roebling's Sons' Company.

One of the very largest wire producers in this country, and probably in the world, is the John A. Roebling's Sons' Company, whose immense plant is located at Trenton, N. J. As indicated in the corporate name of the company, the business is carried on by the sons of the famous engineer, whose name will always be associated with the early development and perfecting of suspension bridge construction.

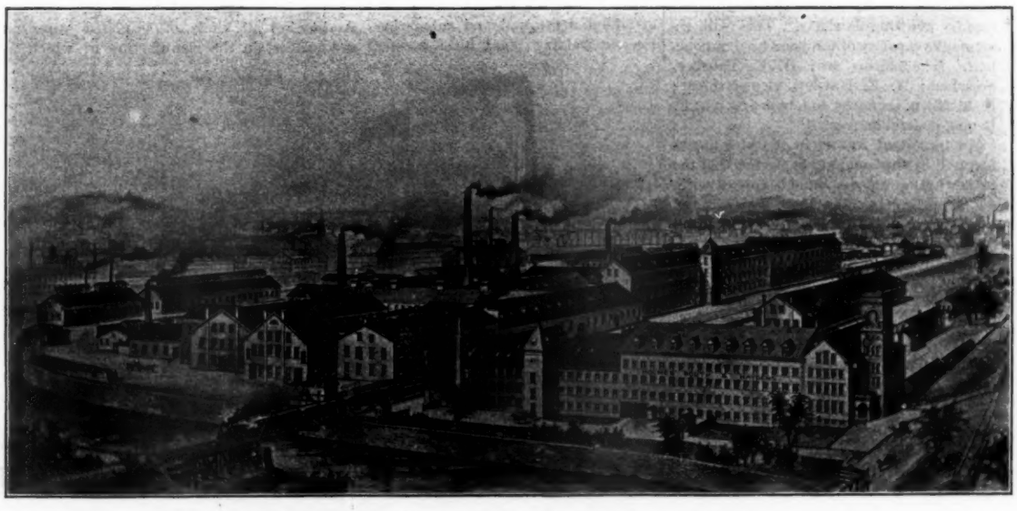
THE OFFICES

of the company are located in the house built by Mr. Roebling, at Trenton, after he had completed the Niagara bridge. This building is delightfully situated, encircled as it is by lawns, shrubs and flowers. From the columned doorway may be seen the surrounding factories which comprise the plant of the company and cover over 25 acres of ground.

The president is Charles G. Roebling; Col. W. A. Roebling is vice-president, and F. W. Roebling is secretary and treasurer. The business was founded in 1850, and every kind of wire for every purpose is now made. About five years ago, the company began to insulate their own wire, and now produce everything from magnet wire to armored cables. Over 2,300 employés are on the pay-rolls.

GROWTH.

In the office is a little pencil sketch of a one story building about 20 feet long. It is



HOLMES, BOOTH & HAYDENS—MILLS AT WATERBURY, CONN.

signed "F. Meissner, 1850." The building was where the first wire was drawn by Mr. Roebling, and stood upon the ground now occupied by one of the largest buildings owned by the company. Mr. Meissner was a cousin of Mr. Roebling's and made the sketch to while away a Sunday afternoon. It has but recently come into the possession of the company, and occupies a prominent position on the wall of the main office.

NEW BUILDINGS.

Constant additions to the plant are necessary to keep up with the demand for the company's productions. A building, 160 feet long, has just been completed, and another of the same size is in process of erection. A large factory over 400 feet long is also being put up.

A large Thomson electric welding plant is in constant use. Three systems of electric lighting, two arc and one incandescent, make it possible to run the factory day and night. Sawyer-Man incandescent lamps are used.

Large warehouses are established in New York, Chicago and San Francisco.

Safety Insulated Wire and Cable Company.

At 234 West Twenty-ninth street, New York, in a six story building, 75x100, is located the plant of the Safety Insulated Wire and Cable Company. All kinds of wire are covered by this firm, which employs 105 hands, making on an average 20 miles of wire and cable per day.

INSTALLATIONS.

In the subways of this city are about 200 miles of this company's cables. The cable, moreover, is giving perfect satisfaction. A contract has recently been made with Gen. Andrew Hickenlooper for 80 miles of aerial electric light wire to be used in Cincinnati. What is believed to be the largest single order for flexible cords ever given out was recently obtained from a Western house by the Safety Company. It calls for 250,000 yards of their flexible cord. This company furnished the lead covered cable used in lighting the Statue of Liberty, in New York Harbor.

ORGANIZATION.

In 1888 the company was formed and at that time occupied part of a floor in the building where they are now located. At present the whole building is occupied, and it will be necessary to secure the whole of the adjoining building to keep up with their rapidly growing business. This will increase the capacity of the plant by about one-half. The officers are: H. K. Thurber, president; H. E. Hawley, vice-president; E. A. Moen, secretary and treasurer; L. F. Requa, general manager.

An important feature in the wire manufactured by this company is the fact that the rubber insulating compound is applied without seam or joint. In their underground cables, the only joint in either wire or insulation is at the manhole.

The Simplex Electrical Company.

The general offices of this company are in the Hathaway Building, 620 Atlantic avenue, Boston. At present the manufacturing plant consists of

TWO FACTORIES,

one at Cambridge, two and one-half miles from Boston, and one at Watertown, four miles from the city. These buildings cover 77,000 square feet of land. The sole business of the company is the manufacture of insulated wires. The number of employés now on the pay-roll is 205. In a year the production from the whole plant amounts to more than

FIVE MILLION POUNDS OF COVERED WIRE.

During the last eight months there have been sent to the city of St. Louis alone, over 1,400 miles of Simplex wires.

In 1885, the present organization of the company was effected. The business was started in a part of a small building at Cottage Farms, a station on the Boston & Albany Railroad, near Boston. Soon after this a factory was operated in Providence, R. I. Then a third branch was organized in Watertown, Mass. Fire destroyed the first factory at Cottage Farms. About this time the company obtained possession of a very large building in Cambridge, Mass., which had been built for a cracker factory. This building was elaborately fitted up in hard woods, with a private counting-room finished in solid mahogany. To these new quarters the Providence branch was removed.

Three years' experimenting produced what this company considers the ideal rubber covering for electrical conductors. At first the manufacture of aerial covered wires was followed exclusively, but now the Simplex wires are

MADE FOR EVERY SERVICE,

aerial, underground and submarine. An electric welding plant is in constant use at the factories, which are illuminated by the incandescent light. A private telephone line, run on the Simplex anti-induction telephone wire, connects the Boston office with the factories.

THE OFFICERS

of the company are A. C. Pond, president; E. H. Batcheler, treasurer; A. F. Mason, general manager, and Jas. H. Mason, secretary.

Standard Underground Cable Company.

This is one of the allied Westinghouse interests. The works are located at Sixteenth and Pike streets, in Pittsburgh. The building is six stories high, each floor being 100x117 feet. A new plant is in process of erection at Brinton, 10 or 12 miles out of Pittsburgh, on the Pennsylvania Railroad. About six acres of ground are owned here by the company. This Summer they will build a factory for making lead covered cable, which will be 75x300 feet, a "compound" factory, 50x80, two stories high, a carpenter shop the same size, one story high, a boiler and dynamo house, and a three story cable wrapping and braiding factory, 65x300. This will leave considerable ground space for

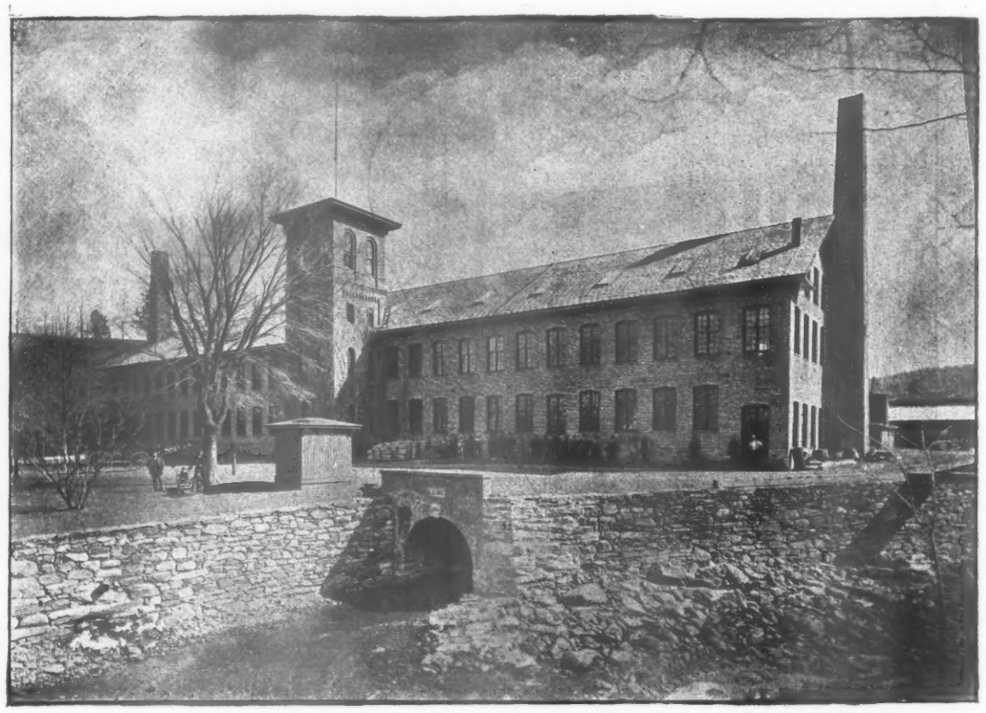
NEW DEPARTMENTS OF WIRE MANUFACTURE

to be erected next year. This company makes all kinds of insulated wires and cables, in the manufacture of which 200 hands are at present employed. The new additions will require 300 hands to operate, bringing the total up to 500.

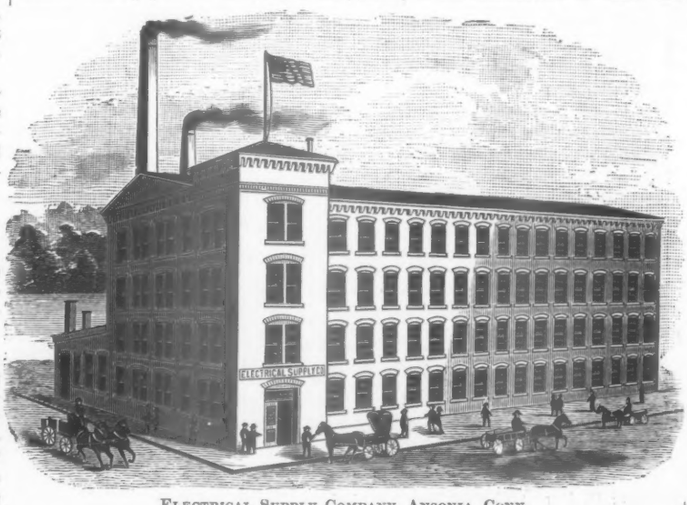
In 1889, the output amounted to $700,000 worth of wire; the business for the first four months of the present year amounts to $325,000.

LARGE ORDERS.

The largest order for electric light cable which the Standard Company filled amounted to $55,000; for fire department cable, $48,000; for telegraph cable, $20,000; for telephone cable, $15,000; for weather proof wire, $27,000. The business was founded in 1882, by Mr. R. S. Waring, in a two story building at the present location. The plant is now running day and night up to its full capacity. Supply depots have been established in all the large cities.



A. G. DAY'S FACTORY AT SEYMOUR, CONN.



ELECTRICAL SUPPLY COMPANY, ANSONIA, CONN.

This company is well known for its very complete hand book which is published regularly. It contains price lists, a general telegraph code, descriptions and illustrations of their manufactures, general and electrical tables, and working directions for laying, splicing and connecting cables, all contained in a book of a convenient size to carry in the pocket.

THE OFFICERS.

George Westinghouse, Jr., president; C. H. Jackson, vice-president and general manager; J. W. Marsh, secretary and assistant general manager; Elmer L. White, treasurer; W. A. Conner, general superintendent of manufacturing department; Geo. L. Wiley, manager Eastern sales department, New York; F. E. Degenhardt, manager Western sales department, Chicago.

Tatham & Brothers.

One of Philadelphia's old established firms is Tatham and Brothers, who have long carried on a business in shot, pig lead, tin and most lead supplies. In 1886, they began covering wire, making lead encased cables a specialty. The building now occupied at 226 South Fifth street is 75x100 feet and six stories high. About 30 hands are employed.

A LARGE ORDER.

A recent large order is for 50,000 feet 110 conductor cable for the Philadelphia Bell Telephone Company. Each of these conductors is covered with paper put on dry, and no insulating compound is used. The electro-static capacity per mile is .049 of a microfarad.

Cable making has become a large and growing department in Tatham & Brothers' business, this year's trade having been better than any previous year. Large orders are coming in all the time, and the capacity of the plant is taxed to keep up with them. An increase in the size of the factory is in view.

The private firm of Tatham & Brothers is composed of Henry B. and William P. Tatham. Mr. Engel is the company's elec-

trician. An arc light plant furnishes illumination for the building.

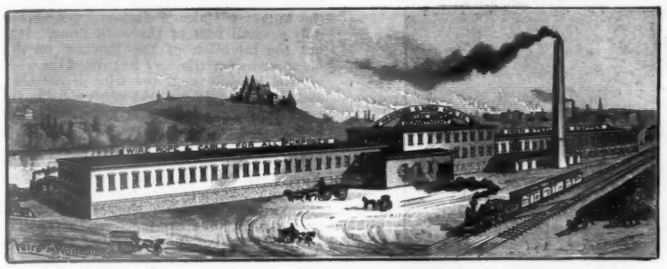
HIGH TESTS.

Some of the cables sent out by this firm have tested as high as 12,000 megohms to the mile. Cables are never sent out which test less than 500 megohms, and the average is about 1,000 megohms. The Bell telephone cable, mentioned above, tested 1,000 megohms with all the wires grounded. It is for use in the city subways. Tatham & Brothers made for the Philadelphia Edison Company an electric light three-wire cable, 2½ inches in diameter, which tested over 500 megohms to the mile. With the insulation used any test almost can be obtained depending upon the amount of drying to which the insulation is submitted. In January, 1886, a 64-wire Bell telephone armored cable was laid across the Delaware river at Philadelphia. It is still in correct service.

near future. A 15 light Brush arc machine is in use at Harrison.

THE OFFICERS.

The officers of the company are as follows: Conrad S. Jordan, president; E. Gogorza, treasurer; James Dunne, secretary; J. R. Burdick, general manager.



WASHBURN & MOEN MANUFACTURING CO.—ROPE FACTORY, WORCESTER, MASS.

Washburn & Moen Manufacturing Company.

One of the largest manufacturing companies in this country is the Washburn & Moen Manufacturing Company, of Worcester, Mass. They make wire exclusively—iron, steel and copper. The growth of Worcester may be said to be almost parallel with that of this immense concern.

The manufacture of wire in Worcester was begun in 1831, by Ichabod Washburn and Benjamin Goddard, in a wooden factory, in the northern part of the town. The factory now standing on this site is the third one built there, the two preceding having been burned.

Mr. Washburn states, in his autobiography, that the first wire machine he ever saw was one of self-acting pincers, drawing out about a foot, then passing back and drawing another foot. With this crude machine a man could draw about 50 pounds of wire per day. For this Mr. Washburn substituted the wire block which is in use at the present time.

In 1850, at the suggestion of Mr. Chickering, of Boston, Mr. Washburn devoted his attention to the production of steel wire for piano-fortes, the manufacture of which had been previously monopolized by several English houses. These experiments were successful; and the English wire was discarded for that made in Worcester. From that time to this the Washburn & Moen Company has been the only manufacturer of music wire in this country.

The first continuous tempering done by Ichabod Washburn, was in 1856; this was music wire, and the hardening was done in water. Early in 1857, oil was substituted for water.

After being engaged in business under numerous firm names, the Washburn & Moen Manufacturing Company was formed on February 24, 1868. The capital was $1,000,000. In 1869, the authority to increase this amount to $1,500,000, the present capital, was granted.

In the fall of 1869 was built the first rolling mill, a "continuous mill" so-called, and in its essential features was an English invention.

The immense plant at present operated by the company consists of two large "works"—the North Works and the South Works, or Quinsigamond Works. The first is located in the northern part of the city of Worcester, and the second in what used to be known as Quinsigamond village. The former covers 20 acres of ground, and the latter 34 acres. A faint idea of the magnitude of this plant may be gained from our illustrations.

The company does nothing but make wire of every description, including barbed wire fencing. One of the most important departments is that where electric wires are manufactured. A large percentage of the bare wire furnished to the manufacturers of insulated wires comes from Washburn & Moen.

The business gives employment to 3,600 hands, not including the office force, which is very large. In a year, 100,000 tons of wire of all descriptions is sent out from this plant. The general growth of the business has been remarkably steady and strong ever since the start.

The company has its own gas and electric light plants. The latter consists of an Edison 100 light incandescent machine, a Brush 450 lighter, and a Westinghouse 500 lighter. At the North Works 28 and at the South Works 15 Brush arc lights are in use.

No electric power is in use, but a large electric welding plant, recently installed, welds the wires into any lengths desired.

In a show case in the office are exhibited two copper wire "whips," each drawn in one piece without a joint, from .880 to .004 of an inch in diameter. Other examples of electric wires are shown, with the insulation by the Western Electric Company.

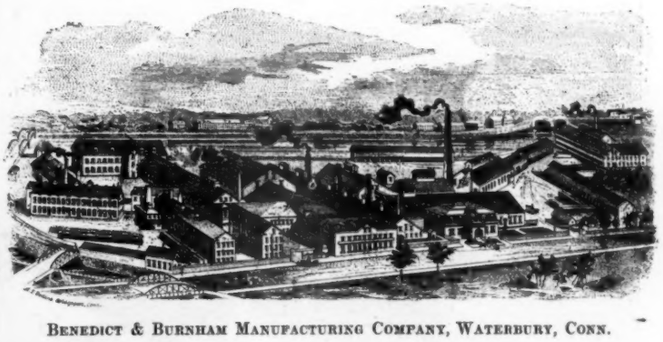
WASHBURN & MOEN MANUFACTURING CO.—SOUTH WORKS, WORCESTER, MASS.

Trinidad-Heimann Insulated Wire Company.

In January of the present year, the Trinidad-Heimann Insulated Wire Company was formed, having bought out the Callender Company, which was organized in 1883. The plant is at Harrison, N. J., and includes three buildings, 175x120, with other smaller buildings. Spurs of the Erie Railroad run into the factories. Trinidad line wire, Heimann fire proof insulated wire and all kinds of covered wire, including a solid system of underground wires, are produced at this plant. About 70 hands are employed and the factory is running at full capacity with orders ahead. The business has enjoyed a rapid increase, a recent order being for 90,000 pounds of wire. All this company's wires are acid proof, even chemically pure nitric acid having no effect. It is expected that a very large increase in the capacity of the plant will be made in the

WASHBURN & MOEN MANUFACTURING CO.—NORTH WORKS, WORCESTER, MASS.

WESTERN ELECTRIC COMPANY—NEW YORK FACTORY.



BENEDICT & BURNHAM MANUFACTURING COMPANY, WATERBURY, CONN.

The officers of the company are as follows: Philip L. Moen, president and treasurer; Chas. F. Washburn, vice-president and secretary; Philip W. Moen, assistant treasurer and general superintendent; Charles G. Washburn, assistant secretary and counsel.

The New York warehouse, at 16 Cliff street, is under the management of Mr. R. K. Dana, a man well known throughout the entire industry. The Chicago warehouse is at 107 and 109 Lake street.

Western Electric Company.

This large organization was formerly known under the name of Gray & Barton. Mr. Elisha Gray is well known in connection with his work on the telephone and telegraph. Mr. Barton is now the president of the Western Electric Company, which in 1882 was reorganized from the Western Electrical Manufacturing Company, this last named company succeeded to the business of Gray & Barton in 1871.

THEIR FACTORIES

are located in New York, Chicago, Antwerp and Berlin. In London a large warehouse and offices are established. All the wire business is done at the Chicago factory, where 500 hands are employed and 60,000 square feet of floor space used.

In 1880, the manufacture of covered wire was commenced. All kinds are now manufactured, a specialty being made of cable work.

FIGURES.

The number of miles of conductor in the cables manufactured during the year ending November 30, 1881, was 56. During the seven months ending in June, 1889, this number of miles had increased to 7,804. Of switchboard cables, there were made during the year ending November 30, 1888, over 5,000 miles. A wonderfully large and growing business is carried on in the cable trade.

The annual output of their wire department amounts to over one million dollars.

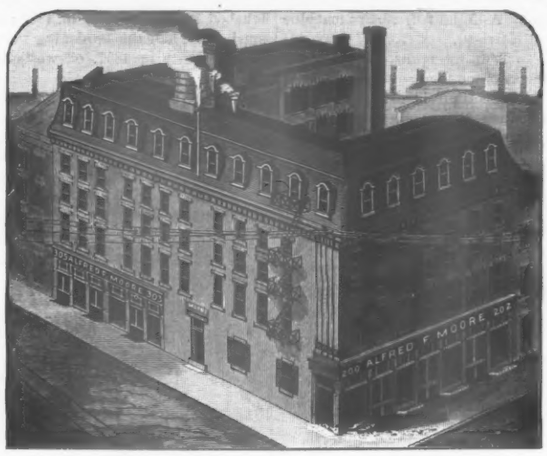
THE OFFICERS

of the company are E. M. Barton, president, and J. M. Jackson, secretary and treasurer.

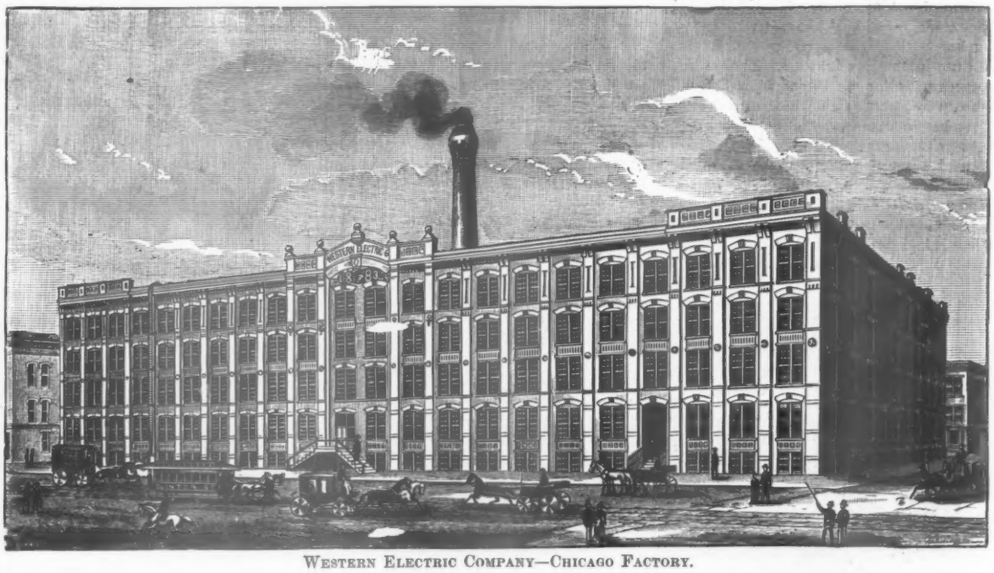
Mr. Patterson, who invented the cable which bears his name, has charge of the Chicago wire making plant. He graduated from Dartmouth College in 1876, and has been with the Western Electric Company ever since a short time after his graduation. He has made other inventions beside the cable. This the company began to manufacture in 1880.

The Western Electric Company is undoubtedly the most widely known general electrical manufacturing company in the world, and although the production of its wires and cables requires several floors in the immense Chicago factory, yet this is only a small part of the work done. It is not the intention of the REVIEW on this occasion to describe any feature of the work of this house except the wire department, and we need only say that it is probably the most representative and comprehensive of any of the electrical manufacturing concerns.

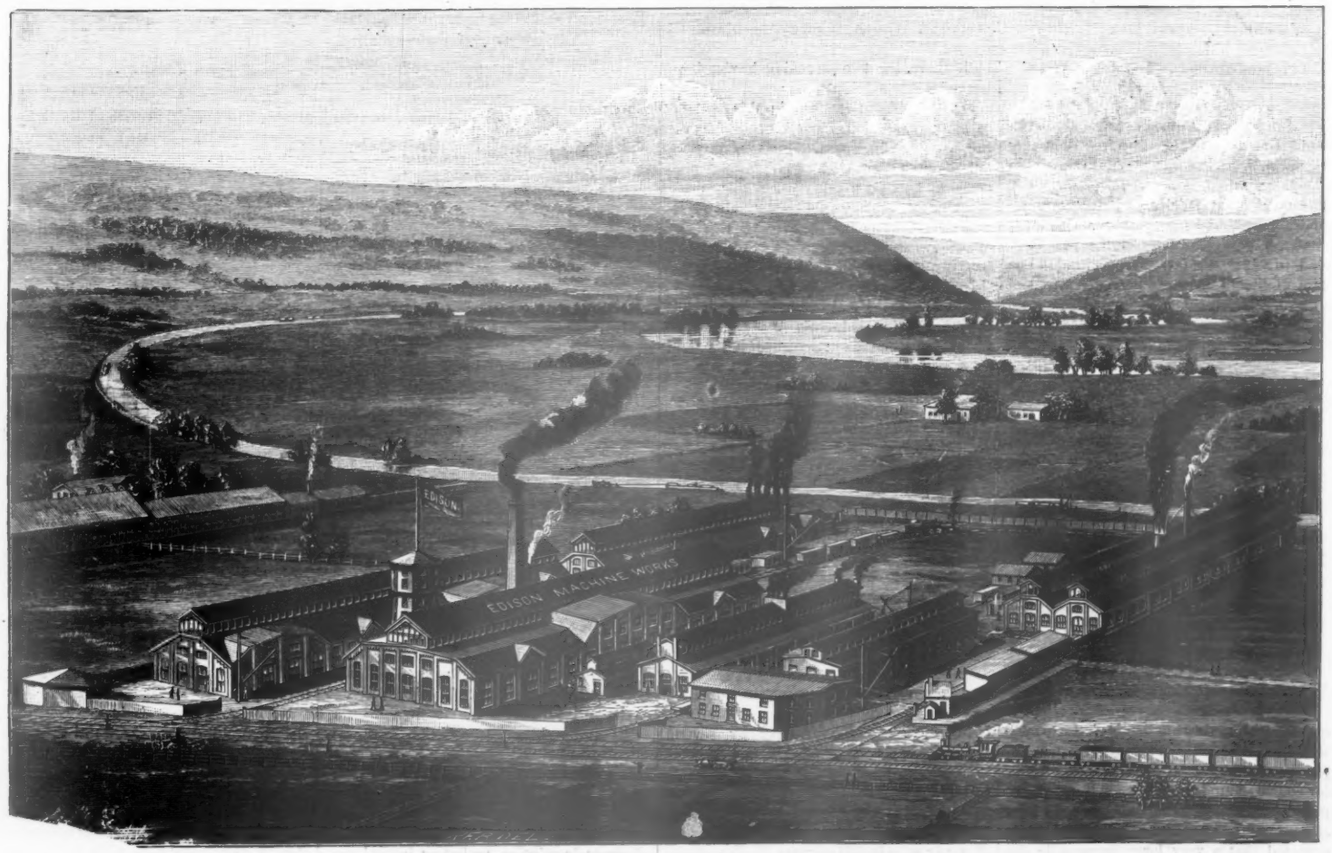
Mr. H. B. Thayer is the manager of the New York house, a view of which is given herewith. He has been connected with the company for a number of years, and has so successfully built up the New York end of the business that it is becoming a question as to whether Chicago or New York leads. Withal, the New York manager is one of the most agreeable gentlemen to meet in the electrical business, and has a popularity attained by few.



ALFRED F. MOORE'S FACTORY AT PHILADELPHIA.



WESTERN ELECTRIC COMPANY—CHICAGO FACTORY.



THE EDISON FACTORY AT SCHENECTADY, N. Y.